6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Oyster Creek Nuclear Generating Station (OCNGS). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The U.S. Nuclear Regulatory Commission (NRC) staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to OCNGS from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is not aware of any new and significant information associated with the renewal of the OCNGS operating license (OL). The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER (2005), the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the NRC staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- <u>Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)</u>. Based on information in the GEIS, the Commission found that

    Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this Part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- <u>Offsite radiological impacts (collective effects)</u>. Based on information in the GEIS, the Commission found that

    The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW and spent fuel disposal excepted, is calculated to be about 14,800 person-rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the United States. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect that will not ever be mitigated (e.g., no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.

Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA [National Environmental Policy Act] implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- <u>Offsite radiological impacts (spent fuel and HLW disposal)</u>. Based on information in the GEIS, the Commission found that

  For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 mrem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 mrem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem per year. The lifetime individual risk from the 100 millirem annual dose limit is about 3×10^{-3}.

Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*, October 1980 (DOE 1980). The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other Federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths, with an upper limit of 1,000 premature cancer deaths worldwide for a 100,000-metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The

U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 (2002) designates Yucca Mountain as the repository for spent nuclear waste. This development does not represent new and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

The U.S. Environmental Protection Agency (EPA) developed Yucca-Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated the EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63. In response to the Court's decision, the EPA issued its proposed revised standards to 40 CFR Part 197 on August 22, 2005 (70 FR 49014). In order to be consistent with the EPA's revised standards, the NRC proposed revisions to 10 CFR Part 63 on September 8, 2005 (70 FR 53313).

Therefore, for the HLW and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the NRC staff assumed that limits would be developed along the lines of the 1995 NAS report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and HLW disposal should be made. The NRC staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

  The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated onsite with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

  No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found that

  The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by the NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4, “Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor.” If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in the summary table.

OCNGS meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. *Code of Federal Regulations*, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

70 FR 49014. August 22, 2005. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." *Federal Register*, U.S. Nuclear Regulatory Commission

70 FR 53313. September 8, 2005. "Implementation of a Dose Standard After 10,000 Years." *Federal Register*, U.S. Nuclear Regulatory Commission.
Joint Resolution Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-Level Radioactive Waste and Spent Nuclear Fuel, pursuant to the Nuclear Waste Policy Act of 1982. 2002. Public Law 107-200. 116 Stat. 735.

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, D.C.

National Environmental Policy Act (NEPA) of 1969, 42 USC 4321, et. seq.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2005. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada." *Federal Register*, Vol. 70, No. 161, pp. 49014–49068. Washington, D.C. (August 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005. "Implementation of a Dose Standard After 10,000 Years." *Federal Register*, Vol. 63, No. 173, pp. 53313–53320. Washington, D.C. (September 28, 2005).

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586, Supplement 1 (NRC 2002). The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1, identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, that are applicable to Oyster Creek Nuclear Generating Station (OCNGS) decommissioning following the renewal term are listed in Table 7-1. AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is aware of no new and significant information regarding the environmental impacts of OCNGS license renewal. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of OCNGS Following the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- <u>Radiation doses</u>. Based on information in the GEIS, the Commission found that

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

> Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

> Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

> The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found that

    > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

    The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic impacts. Based on information in the GEIS, the Commission found that

    > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

    The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there would be no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report,* "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Supplement 1, Washington, D.C.

8.0 Environmental Impacts of Alternatives

This chapter examines the potential environmental impacts associated with (1) alternatives to the Oyster Creek Nuclear Generating Station (OCNGS) cooling-water system; (2) denying the renewal of the OCNGS operating license (OL) (i.e., the no-action alternative); (3) replacing OCNGS electric-generation capacity using electric-generation sources other than OCNGS; (4) purchasing electric power from other sources to replace power generated by OCNGS; and (5) a combination of generation and conservation measures. In addition, other alternatives that were deemed unsuitable for replacement of power generated by OCNGS are discussed. Alternatives to the existing OCNGS cooling-water system are being considered because OCNGS is operating under the provisions of an expired New Jersey Pollutant Discharge Elimination System (NJPDES) permit. The final requirements, limits, and conditions of the renewed permit were not available at the time the U.S. Nuclear Regulatory Commission (NRC) staff performed the assessment presented in this draft Supplemental Environmental Impact Statement (SEIS). Based on the NRC staff's review of the draft permit and discussions with the New Jersey Department of Environmental Protection (NJDEP), the staff has determined that there is a reasonable possibility that OCNGS would be required to either install a closed-cycle cooling system or employ a combination of design and construction technologies, operational measures, and restoration that would result in compliance with the intake performance standards.

The environmental impacts of alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999),[(a)] with the additional impact categories of environmental justice and transportation.

8.1 Alternatives to the Existing OCNGS Cooling-Water System

OCNGS uses a once-through cooling-water system to remove waste heat and condense the main turbine exhaust steam in the station's three main condensers. Cooling water is withdrawn from the intake canal, which pulls water from Forked River and Barnegat Bay. The warmed cooling water is released to the discharge canal and Oyster Creek. Dilution pumps move unheated water from the intake canal to the discharge canal to reduce the added heat load to Oyster Creek. A more detailed description of the OCNGS cooling-water system is provided in Section 2.1.3 of this SEIS. An assessment of the impacts of the current cooling-water system on the environment is presented in Sections 4.1, 4.6, and 4.8 of this SEIS.

Surface-water withdrawals and discharges at OCNGS are regulated under the NJDPES permit program. OCNGS was issued an NJPDES permit in 1994, and that permit expired in 1999. A provision of the Clean Water Act (CWA) allows facilities to operate under an expired permit, provided that the permittee makes a timely renewal application. OCNGS has been operating under the 1994 permit since the permit expired in 1999. The NJDEP issued a draft permit in 2005 (NJDEP 2005) that incorporated the U.S. Environmental Protection Agency's (EPA's) recently issued Phase II regulations for reducing impingement and entrainment losses at existing electric-generating facilities. These regulations establish standards for compliance with the requirements of Section 316(b) of the CWA, which calls for intake structures to reflect the best technology available for minimizing adverse environmental impact. The EPA's Phase II regulations call for reducing the number of organisms impinged at the intake structure by 80 to 95 percent of baseline, and reducing organisms entrained through the cooling system by 60 to 90 percent of baseline (EPA 2004a).

The NJDEP identified two alternatives to the current cooling water system in the 2005 draft NJPDES permit for OCNGS. The NJDEP's preferred alternative is to "reduce intake capacity to a level commensurate with the use of a closed-cycle, recirculating cooling system." This alternative would require replacement of the existing once-through cooling system with a closed-cycle cooling system. The NJDEP indicated that if AmerGen Energy Company, LLC (AmerGen), can demonstrate that a closed-cycle cooling system is not a feasible alternative for OCNGS, AmerGen could implement another alternative, which is to "select, install, properly operate, and maintain a combination of design and construction technologies, operational

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures" endeavor to meet the national performance standards for impingement and entrainment. The impacts of implementing these two alternatives are evaluated in this section.

Uncertainties exist in the design details of alternative systems and the timing of construction activities. Currently, AmerGen is collecting data under a NJDEP-approved Proposal for Information Collection (PIC) which will be part of a series of studies to be prepared by the applicant. The results of these studies (which could take several years to complete) would be used to assist in the selection of an alternative and design the specific characteristics of that alternative. Issuance of a final NJPDES permit for OCNGS may include a time line for implementation. Implementation of either alternative is likely to take years, and construction may extend into the license renewal period. The second alternative considers a requirement to restore wetlands. The initial restoration of wetlands could start prior to license renewal, and continue through some portion of the license renewal period.

8.1.1 Closed-Cycle Cooling Alternative

The NJDEP identified construction and operation of a closed-cycle cooling system at OCNGS as its preferred alternative to meet current national performance standards for impingement and entrainment losses. In a closed-cycle cooling system, the cooling water is recirculated through the condenser after the waste heat is removed, typically by circulating the water through large cooling towers.

The principal types of closed-cycle cooling systems currently used by the power industry are natural-draft and mechanical-draft cooling towers. The method of cooling associated with these cooling towers is the evaporation of water to the atmosphere. Natural-draft towers, with a characteristic hyperbolic shape often associated with nuclear power plants, rely on the passive movement of air through the towers to provide cooling. Natural-draft towers are usually quite large, up to 520 ft in height. Mechanical-draft towers use fans to move air through the towers and are often less than 100 ft tall. In large power-plant applications, mechanical-draft towers are multicelled systems that are arranged in linear or round configurations, and in series or parallel configurations. Natural-draft and mechanical-draft cooling systems are referred to as "wet" closed-cycle cooling systems. "Dry" closed-cycle cooling systems use air to transfer heat to the atmosphere without the evaporation of water. Hybrid mechanical-draft systems combine wet and dry systems to cool water.

Hybrid systems can be configured in a variety of ways to accommodate system throughput parameters and site-specific environmental constraints, such as water and energy conservation. The particular design that is chosen would depend on the objective(s) to be achieved, such as visible plume abatement, water conservation, or plant performance. Plume abatement, which refers to mitigating or eliminating cooling-tower-induced fog, is typically required in applications near major highways, airports, residential areas, or commercial areas. The drawback of this design is the energy penalty that results from the additional energy required to operate the hybrid towers. If both plume abatement and optimum plant performance are the objectives, custom hybrid designs are possible. There are maintenance and operations trade-offs and capital and operational costs that would need to be factored into any system design.

Because natural-draft and mechanical-draft wet and hybrid cooling-tower systems transfer waste heat to the atmosphere by evaporating water, water is naturally lost from the system. This results in an increased concentration of dissolved solids (salts and minerals) in the cooling-system water. Consequently, a fraction of this mineral-rich stream must be discharged to a receiving water body as “blowdown” to maintain proper cooling-system operation. Drift is circulating water, in the form of mist or liquid water droplets entrained in the exhaust air stream, that is transported by the air draft of the tower. Drift droplets contain suspended and dissolved solids that were constituents of the circulating water. The water required to replace water lost through evaporation, blowdown, and drift is called “makeup” water. The number of times water can be recirculated (cycles of concentration) is based on the ratio of total dissolved solids (TDS) in the recirculating (blowdown) water relative to the makeup water. For cooling-water systems that use salt water or brackish water, the industry standard is two or fewer cycles of concentration.

The water evaporated from cooling towers can form a visible plume and lead to localized fogging and icing, depending on atmospheric conditions. Fog formation occurs when warm moist vapor exits the cooling tower, cools to the dew-point temperature or below, and condenses onto condensation nuclei such as sea salt. Condensation occurs because the capacity of air to hold water vapor decreases as the air is cooled. These conditions occur frequently during winter months, but can also occur throughout the year, particularly during the spring or fall. Cooling and fog formation occur readily when the wet cooling-tower air is at supersaturation in the presence of sufficient concentrations of condensation nuclei. If these nuclei are in sufficiently high concentrations, fog formation can occur at less than (but near) saturation levels.

In response to an NRC request for additional information (NRC 2005), AmerGen provided an evaluation of six types of closed-cycle cooling systems: (1) natural-draft, (2) linear mechanical-draft, (3) round mechanical-draft, (4) dry air-cooled, (5) linear hybrid mechanical-draft, and (6) round hybrid mechanical-draft (AmerGen 2006). AmerGen identified a linear hybrid mechanical-draft closed-cycle cooling system, configured in series (dry following wet), as the optimal type for OCNGS (AmerGen 2006). The hybrid design refers to a combination of a wet mechanical-draft cooling tower with a dry air-cooled component added to the top to minimize or eliminate ground fogging. The impacts of constructing and operating a linear hybrid mechanical-draft cooling-tower system were evaluated and are discussed in Section 8.1.1.2.

If plume abatement is not a primary objective, design alternatives exist that could achieve smaller energy penalties required to operate the tower while also allowing for sufficient reduction in the visible plume. One design alternative would be similar to the system selected as the most viable alternative by AmerGen, but with a larger footprint design (e.g., larger cell design) that would provide greater reduction in return water temperature, which would reduce turbine back pressure. Another design alternative would be a parallel wet-dry system, which would provide greater flexibility in setting wet-dry tower cell operation levels (actuator controls on groups of cells) to achieve the greatest plume abatement during the cold winter season and the lowest energy loss during the hot summer season.

8.1.1.1 Description of the Closed-Cycle Cooling Alternative

The following summary description of the linear hybrid mechanical-draft cooling-tower system evaluated in this section is based on information provided by AmerGen (AmerGen 2006), unless otherwise noted.

The linear hybrid mechanical-draft cooling-tower system would include two new cooling-tower units and two new circulating-water pump houses. Heated water from the circulating-water discharge flume would be routed to the cooling towers via a 12-ft-diameter underground concrete pipe. After circulating through the cooling towers, cooled water would be routed to the circulating-water supply flume via a second 12-ft-diameter underground concrete pipe.

The potential location identified for the cooling towers is in the northern portion of the OCNGS site in an area bounded by the intake canal and U.S. Highway 9 (Figure 8-1). Approximately 13.5 ac would be disturbed during construction, with 10 ac permanently converted to structures or impervious surfaces.

Each cooling-tower unit would consist of 18 back-to-back cooling-tower cells installed in two rows constructed of fiberglass with polyvinyl chloride fill. Each cell would contain its own 250-horsepower mechanical-draft fan. Each cell also would include a “dry” section at the top that could be used to add heat to the exhaust plume to dissipate fog when fogging is likely to occur (winter). Each cooling tower would be 80 ft tall and located in a concrete basin 120 ft wide, 500 ft long, and 6 ft deep. The total design flow for the two cooling towers would be 460,000 gallons per minute (gpm). A potential site configuration identifying the cooling tower units is shown in Figure 8-1.

The cooling towers would have two cycles of concentration. The current circulating-water intake would be reconfigured to provide makeup water. The makeup water flow rate would be approximately 14,000 gpm, with 7000 gpm required for water lost to evaporation and drift and 7000 gpm required for water lost to blowdown. The blowdown water would be piped to the existing dilution pump structure and pumped through two of the three existing dilution pumps into the discharge canal. One dilution pump would remain in operation to dilute the blowdown.

AmerGen estimates that construction of the linear hybrid mechanical-draft cooling-tower system would take approximately two years. Construction would require several new structures as well as modifications to existing plant structures. New structures and equipment would include interconnections between the existing intake and discharge flumes and the new circulating-water piping; the two below-grade 12-ft-diameter pipes to convey circulating water to and from the cooling towers; two pumping stations; two cooling-tower units; and cooling-tower makeup and blowdown systems. The two 12-ft diameter circulating-water pipes would be located 60 ft below grade at their deepest point to avoid utility interferences, and would require continuous dewatering during construction. Modifications to existing plant structures and equipment would include the relining of existing cooling-water system flumes with steel plates in response to increased operating and transient pressures, and the replacement of the existing condenser-water boxes.

AmerGen estimates that the implementation of a closed-cycle cooling system would result in a net annual reduction in power production. The annual average power loss at OCNGS is estimated to be 32.5 megawatts electric (MW[e]). This loss is a result of the decrease in the steam turbine efficiency from cooling-tower-induced back pressure during spring, fall, and winter operations, plus the electrical demand required to operate the pumps, fan, and ancillary equipment associated with the cooling towers.

8.1.1.2 Environmental Impacts of the Closed-Cycle Cooling Alternative

This section discusses the impacts that would occur if AmerGen replaced its existing once-through cooling system with the closed-cycle cooling system described in Section 8.1.1.1. The use of linear hybrid mechanical-draft cooling towers would result in a substantial reduction of water withdrawn from Forked River and Barnegat Bay. The assessment examines impacts related to both construction and operation of the linear hybrid mechanical-draft cooling system in each of 10 impact categories. Anticipated impacts of the closed-cycle cooling alternative are summarized in Table 8-1. For most issues, the impacts of operating this closed-cycle cooling system would be less than the SMALL impacts associated with the existing once-through cooling system presented in Sections 4.1, 4.6, and 4.8 of this SEIS. Some increase in impacts would occur to land use, aesthetics (visual and noise), and air quality (salt drift).

- **Land Use**

  Construction of cooling towers on the OCNGS site would disturb approximately 13.5 ac, with 10 ac permanently converted to structures or impervious surfaces such as roadways and parking areas (AmerGen 2006). The towers would be located on the site west of U.S. Highway 9, adjacent to existing OCNGS facilities and the intake canal; this site is currently occupied by grass, shrubs, and trees. The 150,000 yd^3 of excavated soil accumulated during construction would be used for fill material on the site and would not require offsite transportation or disposal (AmerGen 2006).

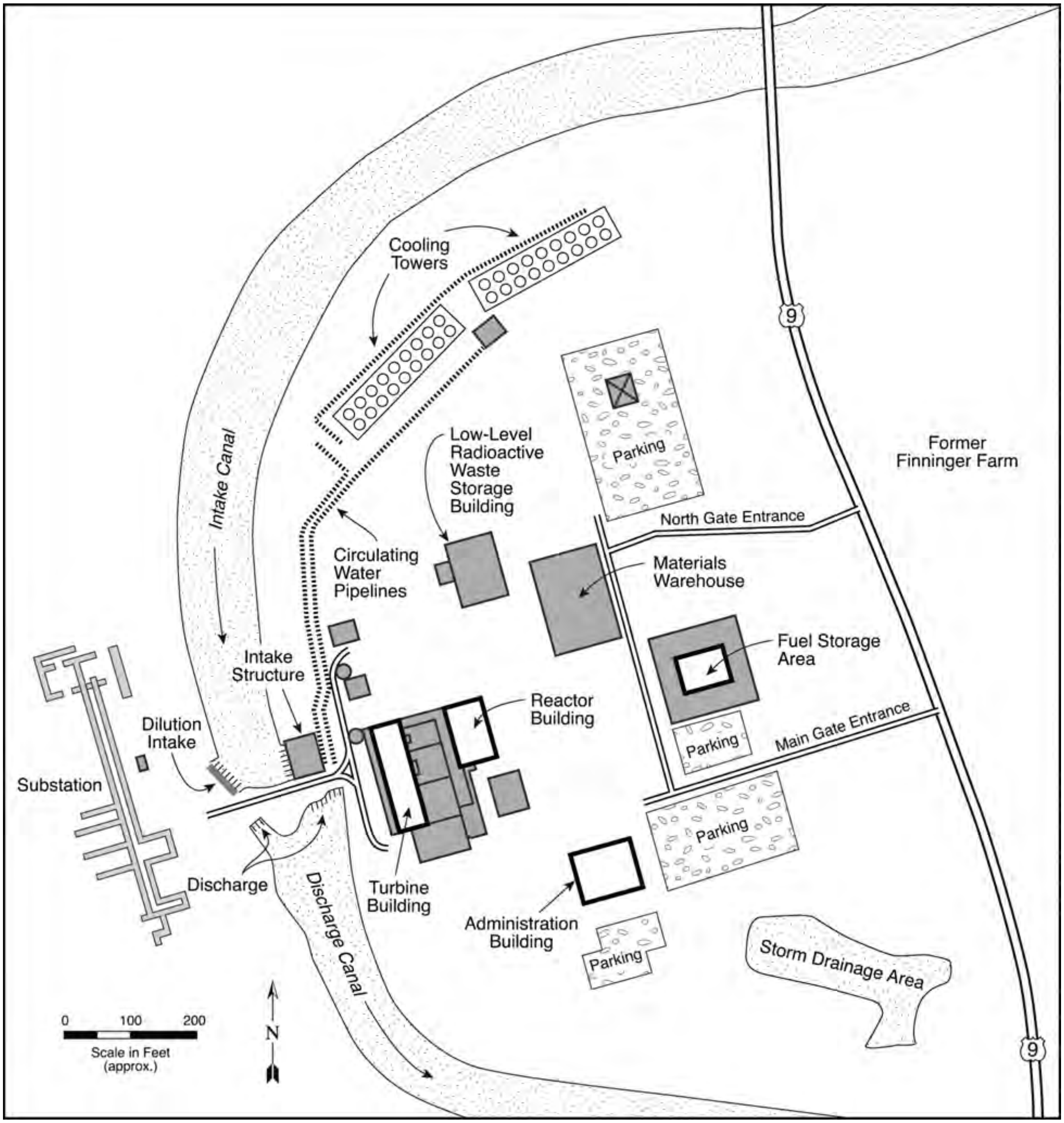

Figure 8-1. Potential Location and Configuration of a Linear Hybrid Mechanical-Draft Cooling Tower System at OCNGS

Construction of the cooling towers at the OCNGS is under the jurisdiction of New Jersey's coastal management program within the NJDEP's Division of Land Use Regulation. Current restrictions under the requirements of the New Jersey Coastal Area Facility Renewal Act (CAFRA) limiting the percentage of impervious surface area for Lacey Township preclude the construction of the cooling basin and towers (AmerGen 2006).

Table 8-1. Summary of Environmental Impacts of a Closed-Cycle Cooling Alternative and a Modified Existing Once-Through Cooling System with Restoration Alternative at the OCNGS Site

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
Land use	SMALL to MODERATE	Would require disturbance of about 13.5 ac of previously disturbed land on the OCNGS site. Would require a variance in restrictions to the percent of impervious land cover on the site. Minor impacts are anticipated to offsite land use.	SMALL to MODERATE	No impacts to onsite land use are anticipated. Would require disturbance of an unknown amount of land for restoration offsite, and restoration could affect land use in the surrounding area. Impact would depend on the location and size of the site chosen.
Ecology – aquatic resources	SMALL	Entrainment and impingement of aquatic organisms would be reduced from current levels commensurate with a 70 percent decrease in water intake rates. Thermal discharge and increased concentrations of salt and contaminants in blowdown would be mitigated with continued operation of the dilution-pump system. Impacts of construction would be reduced using best management practices to control erosion and runoff.	SMALL	Impacts related to entrainment, impingement, cold shock, and heat shock would be less than existing operations. Short-term adverse impacts on aquatic resources would result from restoration activities and could range from SMALL to MODERATE, depending on the location and size of the site chosen. Long-term benefits to aquatic resources from restoration are anticipated.

Table 8-1 (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
Ecology – terrestrial resources	SMALL	Approximately 13.5 ac of previously disturbed terrestrial habitats would be developed. Impacts on wetlands would be avoided to the extent practicable. Salt drift could favor salt-tolerant species adjacent to the cooling towers.	SMALL	No impacts on terrestrial ecology would result from modifications to the existing system at OCNGS. Short-term adverse impacts to terrestrial resources would result from restoration activities and could range from SMALL to MODERATE, depending on location and size of the site chosen. Long-term benefits to terrestrial resources from restoration are anticipated.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides would be released; however, they would be diluted with the dilution-pump system.	SMALL	No change in impacts from current levels are anticipated with operation of a modified once-through cooling system. Restoration activities could produce short-term adverse impacts on surface water, but these would be controlled using best management practices.
Water use and quality – groundwater	SMALL	Short-term dewatering of excavations. Water would not affect groundwater resources.	SMALL	No change in impacts on groundwater from current levels are anticipated with operation of a modified once-through cooling system at OCNGS. No impacts on groundwater are expected from restoration activities.

Table 8-1 (contd)

	Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
		Impact	**Comments**	**Impact**	**Comments**
1	Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality would be MODERATE, with an estimated 261 tons/yr PM_{10} emissions (mostly in the form of salt).	SMALL	No change in impacts on air quality from current levels are anticipated with operation of a modified once-through cooling system at OCNGS. Restoration could have minor short-term impacts if prescribed burning is used to maintain restored sites.
2	Waste	SMALL	Construction waste and small amounts of process waste (e.g., biocides) would be generated and disposed of at approved offsite facilities. Occasional dredging may be required, but spoils would be managed according to State regulations.	SMALL	Construction waste and small amounts of process waste (e.g., biocides) would be generated and disposed of at approved offsite facilities. Restoration activities could produce some wastes (e.g., plant material, soils, and dredged sediments) that would be disposed of according to State regulations.
3	Human health	SMALL	Minor impacts on the public and workers associated with potential exposure to radiation during excavation and construction activities. Minor risk to workers associated with industrial accidents. No impacts on human health during operations.	SMALL	Minor impacts on workers associated with cooling-system modification. Restoration activities would present a slight risk of injuries to workers.
4	Socioeconomics	SMALL	Up to 200 workers would be needed during the peak of the 2-year construction period. An additional 24 workers would be needed during operations. Increases would be unlikely to impact housing and public services. Increases in traffic would be small.	SMALL	Modifications to the existing cooling system would require little if any increase in the workforce at OCNGS. The impacts of restoration on employment and tax revenues would be dependent on the location and size of the site chosen.

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Table 8-1 (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	Comments	Impact	Comments
Aesthetics	SMALL to MODERATE	Minor short-term impacts on visual aesthetics and noise would occur during construction. Operation of cooling towers could produce a visible plume under some atmospheric conditions and also could increase noise levels at offsite locations.	SMALL	Construction activities would not affect significantly visual aesthetics or increase noise levels at OCNGS or surrounding areas. Restoration activities could have short-term adverse impacts on visual aesthetics, but would likely produce a long-term benefit.
Historic and archeological resources	SMALL	A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of construction on cultural resources. Given the fact that the site was previously disturbed, the impacts on cultural resources are expected to be SMALL.	SMALL to MODERATE	No impacts are anticipated on the OCNGS site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of restoration activities. Impacts would depend on the characteristics of the sites chosen.
Environmental justice	SMALL	No significant impacts are anticipated that could affect minority and low-income communities.	SMALL	No significant impacts are anticipated that could affect minority and low-income communities.

The NRC staff concludes that the impact on onsite land use of constructing and operating a closed-cycle cooling system at OCNGS would be SMALL to MODERATE, because of the impervious land cover restrictions.

The development of cooling towers could result in land-use changes offsite. These changes could come as a result of temporary increases in regional population during construction with direct and indirect employment job creation at the site and in the economy of the surrounding area. During operation, local tax revenues may increase because of increases in property taxes levied on the plant leading to the construction of new public service facilities.

Cooling-system construction is likely to employ approximately 200 workers during peak construction months, and 100 workers for the remainder of the 2-year construction period

(AmerGen 2006). Operation of the cooling system would require approximately 24 new permanent employees. A small number of additional jobs would be created indirectly in the region as a result of construction and operation of the cooling system. Compared with total employment in the regional economy, increases in direct and indirect employment would be minor, and would be unlikely to impact land use.

Construction of the closed-cycle cooling system at the site would increase the value of OCNGS property, producing a small increase in property tax revenues for Lacey and Ocean Townships during plant operation. Compared with the existing property tax base, however, these increases are expected to be inconsequential, and not likely to result in any impacts on offsite land use.

The NRC staff concludes that the impact on offsite land use of construction and operation of a closed-cycle cooling system would be SMALL. This is because there would be no utilization of any offsite land for construction and operation of the closed-cycle cooling system, and because changes in land use resulting from increased employment and tax revenues would be very small compared with existing levels in the township and county.

- **Ecology**

Aquatic Ecology. Construction of the alternative closed-cycle cooling system may create short-term, localized impacts on aquatic resources from site runoff; these can be mitigated, however, through the use of physical barriers (e.g., silt fences and hay bales) or sediment traps. Because this alternative uses the existing intake, dilution-pump, and discharge systems, construction-related impacts would be reduced.

The closed-cycle cooling alternative would greatly reduce entrainment and impingement losses when compared with the existing once-through cooling system. The highest water use is expected to occur during the summer when the system functions in full evaporative-mode cooling. Using this operational mode, approximately 274,000 gpm (dilution and makeup water) would be withdrawn from the Forked River, representing a 70 percent reduction in water use relative to the existing once-through system. This would result in a substantial reduction in entrainment-related losses relative to the losses sustained by the current once-through cooling system.

Using full evaporative-mode cooling, approximately 14,000 gpm of makeup water would be withdrawn from the Forked River through the existing circulating-water intake that utilizes Ristroph traveling screens and a fish-return system. Half of this water is evaporated in the cooling tower, and the remainder is discharged into Oyster Creek through the existing discharge canal. The existing dilution-pump system would be used to withdraw approximately 260,000 gpm from the Forked River and discharge it directly into Oyster Creek. The dilution-pump system includes trash racks but no traveling screens. Although impingement would be substantially reduced by using this system, the reductions in impingement losses would only be evident for those species known to have high impingement mortality (e.g., bay anchovy [*Anchoa mitchilli*], Atlantic silverside [*Menidia menidia*], and Atlantic menhaden [*Brevoortia tyrannus*]; see Section 4.1.2). Species with low impingement mortality (winter flounder [*Pseudopleuronectes americanus*], sand shrimp [*Crangon septemspinosa*], and blue crab [*Callinectes sapidus*]) would be less affected by this alternative. The reduction in flow may also reduce sea turtle impingements.

Under the closed-cycle cooling alternative, most water discharged into Oyster Creek would be unheated water from the Forked River that is discharged through the dilution-pump system. Thus, it is likely that any thermal impacts would be confined to an even smaller part of the discharge canal and Oyster Creek, and the thermal plume that currently exists in Barnegat Bay would be significantly reduced.

Under the closed-cycle cooling alternative, evaporative cooling may result in the discharge of higher salinity water containing higher concentrations of biocides, minerals, trace metals, or other chemicals or constituents when compared with the discharge water characteristics associated with the existing once-through system. These impacts would be mitigated by the continued operation of the dilution-pump system, which would represent approximately 95 percent of the flow into the discharge canal under full evaporative-mode cooling.

The NRC staff made the determination that the impacts of the existing once-through cooling system on aquatic resources would be SMALL. Operation of the closed-cycle cooling alternative would produce fewer impacts to the aquatic environment. The NRC staff concludes that the aquatic ecological impacts (including those on threatened and endangered sea turtles) from the construction and operation of the closed-cycle cooling alternative at the OCNGS site would be SMALL.

<u>Terrestrial Ecology</u>. Construction of the closed-cycle cooling system would disturb 13.5 ac, with 10 ac permanently converted to structures or impervious surfaces. The area to be disturbed consists mostly of grasses, shrubs, and several mature trees (AmerGen 2006). The wetlands and their transition areas that occur within the 27.7-ac project area would be avoided to the extent practicable. A wetland determination and transition area determination would be undertaken prior to construction and, if necessary, a Freshwater Wetlands Permit and Transition Area Waiver would be required from the NJDEP (AmerGen 2006). Impacts on terrestrial ecology would include localized habitat loss and fragmentation, reduced productivity, and reductions in biological diversity. During the construction period, less mobile wildlife could be adversely affected, and some wildlife disturbance could occur from noise and the presence of construction personnel. Preconstruction surveys for threatened and endangered species would be necessary to determine if these species are present, and if any species are identified, potential agency constraints or mitigation may be required.

Fogging, humidity, and icing from cooling towers would be largely eliminated by the use of the hybrid cooling system; therefore, impacts on crops and ornamental vegetation from these events would be negligible. However, salt deposition from cooling-tower drift, even with the use of drift-elimination technology, could affect vegetation. In the EIS for the Forked River Nuclear Station (AEC 1973), which would have been located adjacent and to the west of OCNGS, it was stated that the chloride content of the surface soils within a 5-mi radius of the proposed plant averaged about 6 parts per million (ppm) and about 0.5 to 0.6 ppm of chloride might be expected to be contributed by the operation of the plant's saltwater cooling tower. Salt deposition below 8.9 lb/ac/month is not expected to cause visible leaf damage (NRC 1996). On average, salt deposition below this level would occur at distances greater than 2600 ft from the cooling towers; however, in the west direction, salt deposition below this level would occur at distances greater than 4300 to 4600 ft from the cooling towers (AmerGen 2006).

Most native and invasive species (such as the common reed [*Phragmites australis*]) that occur near the bay are salt tolerant; however, ornamental plants and some vegetation in natural habitats such as pinelands and wetlands may be adversely affected by localized salt deposition. Long-term impacts near the OCNGS may result in a gradual change in some plant communities from salt-sensitive to salt-tolerant species (AEC 1973). Thus, the potential impact on vegetation from cooling-tower drift would likely be a small incremental increase over natural background concentrations (AEC 1974).

The cooling towers would be about 80 ft tall and would produce minimal ground fog and visible plume (AmerGen 2006). As a consequence, collisions of birds (including the bald eagle [*Haliaeetus leucocephalus*], a Federally listed species that could occasionally occur in the area) with the towers are expected to be negligible (NRC 1996). Noise from cooling-tower operations may cause localized disturbance to wildlife, although resident wildlife would be expected to acclimate to this noise source. No other wildlife impacts would be expected from cooling-tower operations.

Overall, the NRC staff concludes that the terrestrial ecological impacts (including those to threatened and endangered species) from the construction and operation of the closed-cycle cooling system alternative at the OCNGS site would be SMALL.

- **Water Use and Quality**

During construction of the alternative closed-cycle cooling system at OCNGS, changes in water usage would likely be negligible. Potable water demand for workers may increase, but commonly used portable toilet facilities would lessen the overall water demand on site of the worker population. If concrete is mixed onsite, water needs would be a short-lived demand on site water resources. This water would likely come from the site's two wells, which, as discussed in Section 2.2.2, are typically pumped far below their capacities or their permitted rates.

Below-ground construction operations, such as the installation of two circulating-water pipelines, would create a need for localized dewatering of the Cape May Formation and the Miocene Cohansey-Kirkwood Formation. For the dewatering, a permit would be needed from the NJDEP (AmerGen 2006).

Construction of the closed-cycle cooling system would require an NJPDES permit for stormwater discharges from construction activities, in the form of a Construction General Permit issued by the Ocean County Soil Conservation District (AmerGen 2006). In addition, a Soil Erosion and Sediment Control Plan would need to be certified by the Ocean County Soil Conservation District. The use of silt fencing and other erosion-control practices during construction could minimize impacts on surface-water quality.

Construction of the closed-cycle cooling system would result in increased impervious surface cover, which is regulated under CAFRA. According to AmerGen (2006), it is uncertain whether the site's surface cover after the construction of cooling towers would meet CAFRA requirements. Further discussion of this topic is provided under the above land-use discussion.

During the operations of the closed-cycle cooling system, evaporative losses would amount to an estimated 7000 gpm, with makeup water taken from the intake canal (AmerGen 2006). Because of evaporation, the concentrations of dissolved and suspended solids in the circulating water would increase. These minerals would affect the operation and efficiency of the system because of scale deposits. A portion of the circulating water known as blowdown would be removed from the circulating-water system at a rate of 7000 gpm. This water would have a higher mineral content but would be diluted in the discharge canal by a dilution pump operating at 260,000 gpm (AmerGen 2006). The reversed-flow condition in the portion of the Forked River between the intake canal and Barnegat Bay would likely be maintained because of the continued operation of one dilution pump, but the flow rate in the Forked River would decrease substantially.

Makeup water would be withdrawn from the intake canal through the intake structure and would pass through filter skids to remove silt, suspended solids, biological material, and windblown debris (AmerGen 2006). Makeup water may need lime softening, resulting in a sludge that requires disposal (AmerGen 2006). Because of the warm environment in the closed-cycle system, biofouling organisms would be expected, and biocides, such as sodium hypochlorite, would be needed (AmerGen 2006). Other chemicals, such as acids, dispersants, scale inhibitors, foam suppressants, and dechlorinators may be needed (AmerGen 2006). The use of biocides or any other chemicals would require a revision to the NJPDES permit and ongoing monitoring (AmerGen 2006). Storage of additional chemicals at the facility could require a new or modified Discharge Prevention, Containment, and Countermeasure Plan and a Discharge Cleanup and Removal Plan (AmerGen 2006).

On the basis of these considerations, the NRC staff concludes that impacts of the closed-cycle cooling system alternative on surface water and groundwater use and quality would be SMALL.

- **Air Quality**

In assessing the impacts of constructing a closed-cycle system at OCNGS, the following assumptions were made based on AmerGen (2006): (1) construction would occur over a 2-year period; (2) 200 construction workers (100 workers for each of two shifts) would work over a 150-day period; (3) the balance of construction days would require 100 construction workers divided evenly between two shifts; and (4) the construction workforce would commute from within a 50-mi radius of the site.

Emissions generated during construction would consist of exhaust emissions of carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), sulfur oxides (SO_x), and particulate matter (particulate matter with a mean aerodynamic diameter of 10 μm or less [PM_{10}]) from operation of gasoline and diesel-powered heavy-duty construction equipment, delivery vehicles, and worker's personal vehicles. Site clearing and excavation would generate fugitive dust (PM_{10}). Fugitive dust would also be generated from vehicular onsite construction traffic. The disturbed area for the cooling towers, pipelines, roadways, and laydown areas is estimated to be 13.5 ac. Given the small disturbed area that would be involved and commitment to best management construction practices (e.g., watering, silt fences, covering soil piles, revegetation, etc.), the fugitive dust impacts generated during construction should be minor. VOC emissions would be generated from asphalt paving and painting activities. The amount of pollutants emitted from construction vehicles and equipment and construction worker traffic would be small compared with total vehicular emissions in the region.

As noted in Section 3.3 of the GEIS (NRC 1996), a conformity analysis is required for each pollutant where the total direct and indirect emissions caused by a proposed Federal action would exceed established threshold emission levels in a nonattainment or maintenance area. Because of Ocean County's ozone nonattainment status, the generation of NO_x and VOCs, which combine in the presence of heat and sunlight to create ozone, is a source of concern. The generation of CO is also a potential concern because of the county's status as a CO maintenance area. New Jersey's threshold rates are a net increase of 25 tons/yr for VOCs, 25 tons/yr for NO_x and 100 tons/yr for CO (Table 3 of Title 7, Chapter 27, Subchapter 18, of the *New Jersey Administrative Code* [NJAC 7:27-18.7]). Since the estimated annual emissions (using emission factors from EPA 1995a) for all three pollutants are less than these threshold levels, a conformity determination would not be required (AmerGen 2006).

The design for the proposed hybrid cooling system would have the wet portion of the system operating fully and continuously throughout the year and the dry portion of the system off in the summer and in full operation the rest of the year. During times when fogging is most likely to occur (winter, spring, and fall), the tower would be operated in a combined mode with the dry section adding heat to the exhaust plume to dissipate the visible fog. During seasons when fogging is least likely to occur (summer), the tower would be operated in the full wet mode typical of operation of a conventional mechanical-draft cooling tower (AmerGen 2006).

Because the wet section of the linear hybrid-mechanical draft cooling-tower alternative would always be operated in a fully opened mode (AmerGen 2006), the direct contact between the cooling water and the air passing through the tower would cause some water to be entrained in the air stream and to be carried out of the wet section of the tower as drift droplets. As the water component of the drift evaporates in the atmosphere, dissolved and suspended solids in the water droplets become suspended particulates, which are typically classified as PM_{10} emissions. To minimize PM_{10} emissions, the OCNGS cooling towers would incorporate drift-elimination devices,[a] which are now designed to be capable of achieving a maximum drift-reduction level of 0.0005 percent of the amount of circulating-water flow. Since the actual magnitude of the drift losses is influenced by the number and size of droplets produced within the cooling tower, which in turn are determined by the fill design, the air and water flow patterns, and other interrelated factors, the actual achievable drift reduction would vary. Tower maintenance and operation levels also can influence the formation of drift droplets. For example, excessive water flow and excessive airflow can influence water bypass of the drift eliminators, which can increase drift emissions.

The primary air pollutant of concern associated with the operation of the mechanical-draft hybrid cooling-tower alternative at OCNGS is particulate matter (PM_{10}) emissions from

(a) High-efficiency drift eliminators of modern design can potentially control the drift to less than 0.0005 percent of the cooling-tower circulating-water flow. The drift eliminators used in cooling towers rely on inertial separation caused by direction changes while passing through the eliminators. Drift eliminators can be configured to include herringbone (blade-type), wave form, and cellular (or honeycomb) designs. The cellular units generally are the most efficient. Drift eliminators may include various materials, such as ceramics, fiber-reinforced cement, fiberglass, metal, plastic, and wood, installed or formed into closely spaced slats, sheets, honeycomb assemblies, or tiles (EPA 1995a). Some of the new designs use materials and unique configurations that include other features, such as interlaced monofilaments, each forming a V-shaped arrangement to enhance the drift removal further.

cooling-tower drift. These emissions can be estimated with the following operating parameter assumptions: (1) a water circulation rate of 460,000 gpm and (2) drift controlled to 0.00005 percent of the circulation rate. The maximum total suspended solids (TSS) and TDS in the circulating water are estimated to be 2.5 x 10^9 ppm (AmerGen 2006). Intake water density at the surface is 64.12 lb/ft^3 (3.5 percent salt content).

With these data, the total drift emissions rate from both cooling towers (salt, other TSS, and TDS) can be calculated as 60 lb/hr or 261 tons/yr. Approximately 70 percent of the drift is salt, with the remainder being impurities (e.g., chemical additives and bay water contaminants) in the circulating and makeup water. These drift emissions would exceed the threshold for major air pollution sources and would exceed the current NJDEP emission limit of 30 lb of particulate matter[a] per hour (as provided at NJAC 7:27-6). Since the salt drift alone would exceed the State standard, water-contaminant treatment options (e.g., filtration) would not achieve compliance. AmerGen (2006) has examined saltwater desalinization technology and determined it to be cost-prohibitive. The hybrid closed-cycle cooling tower would need a Prevention of Significant Deterioration (PSD) construction permit and a Title V operating permit from the state, since the potential to emit PM_{10} exceeds 250 tons per year.

Since the potential to emit PM_{10} exceeds the 250 tons/yr major source definition under the Prevention of Significant Deterioration (PSD) new-source construction and under the Title V operating permit regulations of the Clean Air Act (CAA), the alternative closed-cycle hybrid cooling tower would need a PSD construction permit and a Title V operating permit from the State.

AmerGen estimated air quality impacts associated with cooling-tower drift emissions by using a standard EPA conservative screening model called SCREEN3 (EPA 1995b). The screening analysis showed, even with the optimal drift-eliminator efficiency of 0.0005 percent, that the predicted downwind concentrations of PM_{10} emitted from the cooling tower would exceed the Federal and State ambient air quality standards, and the PSD PM_{10} Class II increments. State permitting requires demonstration of compliance with all Federal and State ambient air quality standards and the application of Best Available Control Technology for a new cooling tower installed at OCNGS.

The assessment of drift-deposition impacts of the proposed hybrid cooling-tower design would require application of applicable cooling-tower plume thermodynamics and buoyancy influences. The Seasonal Annual Cooling Tower Impact (SACTI) Code (EPRI 1987) was used to evaluate impacts of salt drift from linear hybrid mechanical-draft cooling towers at

(a) Particles are defined in NJAC 7:27-6.1 as "any material, except uncombined water, which exists as liquid particles or solid particles at standard conditions."

OCNGS (AmerGen 2006). The drift was modeled in the normal spring (wet-dry), summer (wet only), and fall (wet/dry) operational modes. The model results show that the maximum salt deposition of up to 60 lb/ac/month of salt could occur in the area near the switchyard during fall operations. On average, at 2600 ft and beyond, salt deposition remained below 8.9 lb/ac/month, NRC's level of significance for visible leaf damage (NRC 1996). However, with winds out of the east, deposition would be 22 lb/ac/month at 2600 ft in the spring. Surface salt deposition west of OCNGS would fall below the NRC level of significance at downwind distances between 4300 and 4600 ft when winds are from the east (AmerGen 2006).

For the linear hybrid mechanical- draft cooling-towers considered in this assessment, the average annual net power loss or energy penalty over the four seasons was estimated to be 32.5 MW(e) (AmerGen 2006). This loss in power production at OCNGS could be offset by energy conservation, purchased power, generation at existing plants on the grid, or new power generation facilities. Although the replacement power would result in some impacts, it is expected that these impacts would be negligible and spread throughout the grid.

On the basis of the above considerations, the NRC staff concludes that the direct and indirect impacts of the alternative closed-cycle cooling system on air quality, particularly those related to increases in PM_{10}, which would result from salt drift, would be MODERATE. The new system would require a State permit for construction and operation, which would require air emissions within acceptable levels.

- **Waste**

Construction of the closed-cycle cooling alternative at OCNGS would generate some construction debris that would require disposal. Approximately 150,000 yd^3 of soil would be excavated during construction and used as fill material on the site. All construction-related waste would be disposed of at approved offsite facilities and in accordance with State regulations. As discussed in Section 2.2.3, sampling at OCNGS has identified several areas of chemical and radiological soil contamination that resulted from historical onsite releases. A number of these areas already have been excavated, removed, and disposed of in accordance with applicable regulations, and the likelihood of encountering significant contamination is considered small. Appropriate sampling and monitoring would be conducted before and during construction, and disposal of contaminated soils is not expected to become an issue.

Small amounts of biocides or other materials used in the cooling system would be produced during operations. Some of this material would be released to the environment in the blowdown water released to the discharge canal and Oyster Creek in accordance with the station's NJPDES permit. Any other such waste would be managed and disposed of in accordance with applicable State regulations at approved offsite facilities. The decrease in flow in the intake and discharge canals and in Forked River and Oyster Creek could change rates and patterns of sediment deposition, and periodic dredging could be required to maintain navigability. Dredge spoils would be managed according to State regulations.

On the basis of these considerations, the NRC staff concludes that waste-related impacts associated with the closed-cycle cooling alternative at OCNGS would be SMALL.

- **Human Health**

Potential human health impacts that could occur during construction of the closed-cycle cooling system at OCNGS include radiological impacts on members of the public and workers and industrial-type accidents and injuries. If current mitigation and as-low-as-reasonably-achievable (ALARA) practices are performing properly, additional mitigation would not be necessary and radiological human health impacts during construction would be inconsequential. AmerGen (2006) provided a site-specific estimate of the radiological dose to workers during OCNGS cooling-tower construction that is a small fraction of the refurbishment dose estimate presented in the GEIS (NRC 1996) for boiling-water reactors.

As discussed in Section 2.2.3 of this SEIS, sampling at OCNGS has identified several areas of chemical and radiological soil contamination that resulted from historical onsite releases. A number of these areas have been excavated, removed, and disposed of in accordance with applicable regulations. With appropriate workplace sampling, monitoring, and industrial hygiene practices, potential soil contamination is not expected to result in significant impacts on human health during cooling-tower construction activities.

During construction activities, there would be a relatively small risk to workers from typical industrial incidents and accidents. Accidental injuries are not uncommon in the construction industry, and accidents resulting in fatalities do occur. However, the occurrence of such events is mitigated by the use of proper industrial hygiene practices, worker safety requirements, and training.

Occupational and public health impacts during construction are expected to be controlled by continued application of accepted industrial hygiene, occupational health, and ALARA practices. Based upon the discussion presented above, the NRC staff concludes that human health impacts during construction of the closed-cycle cooling system would be minimal.

Potential impacts on human health from the operation of closed-cycle cooling towers at nuclear power plants are evaluated in Section 4.3.6 of the GEIS (NRC 1996). The GEIS evaluation focuses on the threat to occupational workers from microbiological organisms whose presence might be enhanced by the thermal conditions found in cooling towers. The microbiological organisms of concern are freshwater organisms. The closed-cycle system at OCNGS would operate using salt water for the circulating-water flow; consequently, enhancement of microbiological organisms is not expected to be a concern.

Therefore, the NRC staff concludes that there would be no impacts of microbiological organisms on human health during the renewal term under the closed-cycle cooling system alternative.

With respect to potential radiological impacts on workers and the public, the NRC staff concludes that operation of a closed-cycle cooling system at OCNGS would not result in any measurable increase in worker exposure or radiation dose to a member of the public. Overall, human health impacts for the closed-cycle cooling-system alternative at OCNGS would be SMALL.

- **Socioeconomics**

Construction and operation of the closed-cycle cooling system at OCNGS could result in adverse impacts on housing, public services, and traffic in the local area. Impacts would result if increases in employment at the site were large compared with existing employment levels in the local economy, and if the majority of construction and operations workers were to move into the area from elsewhere, creating higher demand for public services that may not be supported by increases in local tax revenues.

Construction of the system is likely to employ approximately 200 workers during peak construction months, and 100 workers for the remainder of the 2-year construction period (AmerGen 2006). Operation of OCNGS with a closed-cycle cooling system would result in the addition of 24 permanent employees to the operational workforce of 470. A small number of additional jobs would be created indirectly in the surrounding region. Compared with total employment in the region, increases in direct and indirect employment would be small. Additionally, because few if any of the additional workers are likely to migrate into the area from elsewhere, the projected small increase in employment would be unlikely to impact housing and public services. Increases in traffic on U.S. Highway 9, which carries between 14,660 and 20,926 vehicles per day (AmerGen 2005), also would be SMALL.

During construction and operation of the closed-cycle cooling system at OCNGS, changes in employment at the site and in the region would be small compared with existing employment levels, and increases in employment are not expected to lead to the in-migration of people from outside the region. The NRC staff concludes that the impact of construction and operation of a closed-cycle cooling system at OCNGS on housing, public services, and traffic would be SMALL.

- **Aesthetics**

During construction of a closed-cycle cooling system at OCNGS, there would be impacts on aesthetics, both in terms of visibility and noise. These are expected to be minor, however, because of their relatively short duration and the presence of vegetative buffers around construction areas.

The hybrid mechanincal-draft towers are expected to be approximately 80 feet tall and would be visible from most directions, including from Highway 9, the Garden State Parkway, Seaside Park, NJ, and the Barnegat Bay shoreline. For comparison, the height of the reactor building is 119 ft and the single stack is 368 ft high.

Operation of the hybrid mechanical-draft cooling towers might produce visual impacts if the plume from the towers were to produce significant quantities of fog and ice associated with the condensation of cooled water vapor. Salt deposition from the plume may also increase dampness and corrosion on surrounding property, which could impact the visual environment. The hybrid mechanical-draft cooling towers under consideration are designed to reduce fog and ice production in the local area. Hybrid mechanical-draft towers could produce more noise than mechanical-draft cooling towers because of the additional noise produced by heat exchangers and the mixing of air in each cooling unit (AmerGen 2006). The operation of cooling fans may also represent a major source of additional noise. It is possible that noise levels at the nearest residential structure would exceed State noise limits, even with the installation of cooling tower silencing modifications. In the event of high noise impacts, the utility would investigate the possibility of exemptions from local ordinances, land easements, or silencing technologies (AmerGen 2006).

The NRC staff concludes that the impact of construction and operation of a closed-cycle cooling system at OCNGS on aesthetics and noise would be SMALL to MODERATE, based on the size of the cooling towers, the extent of mitigation of fog and ice resulting from condensation of cooled water vapor, and noise levels that would occur at offsite locations.

- **Historic and Archaeological Resources**

The OCNGS site has not been surveyed for historic and archaeological resources, and the potential exists for resources to be present within the site boundaries. Therefore, prior to any ground-disturbing activity, an archaeological survey of the 13.5-ac area proposed for construction of the closed-cycle system would have to be conducted by qualified archaeologists in consultation with the New Jersey State Historic Preservation Office (SHPO) and appropriate Native American Tribes, as required under Section 106 of the National Historic Preservation Act (NHPA). Although the area was disturbed during the original construction of the station, archaeologists would evaluate the level of disturbance to determine whether any intact subsurface resources could be present and develop a survey strategy on the basis of their preliminary evaluation. Although it is unlikely that intact archaeological deposits are present, insufficient data exist to eliminate the possibility of site presence without an on-the-ground inspection. If archaeological resources are present, they would have to be evaluated for eligibility for listing on the National Register of Historic Places (NRHP). No further action would be required of ineligible sites as long as the SHPO and Native American tribes concur with the determination. Eligible sites would require mitigation (e.g., avoidance or data recovery). Mitigation would be determined in consultation with the SHPO and Native American tribes; construction would be able to start once the mitigation efforts are completed and the results accepted. Although impacts of constructing a closed-cycle cooling system at OCNGS could range from SMALL to MODERATE, the impacts would most likely be SMALL because of the small likelihood of intact significant archaeological resources in this mostly disturbed portion of the site, and the ability to mitigate impacts if a significant site is found.

In the SHPO's opinion, the right-of-way of the Garden State Parkway is eligible for the New Jersey State Register of Historic Places. No visual impact on historic resources, including the Garden State Parkway, is anticipated as a result of operation of the closed-cycle cooling system. The impacts of operation of a closed-cycle cooling system on historical and archaeological resources would be SMALL.

- **Environmental Justice**

Construction and operation of cooling towers at OCNGS would have an impact on environmental justice if environmental impacts of cooling-system construction and operation affected minority and low-income populations in a disproportionately high and adverse manner.

Based on NRC staff guidance (NRC 2004), air, land, and water resources within 50 mi of the OCNGS site were examined. Within that area, a few potential environmental impacts (onsite land use, visual aesthetics, noise, PM_{10} emissions) could affect human populations in the immediate vicinity of the site but not in the areas where minority and low-income populations occur. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which minority and low-income populations could be disproportionately high and adversely affected. The NRC staff concludes that the environmental justice impacts of constructing and operating a closed-cycle cooling system at OCNGS would be SMALL.

8.1.2. Modified Existing Once-Through Cooling System with Restoration Alternative

The NJDEP identified construction and operation of a closed-cycle cooling system (Section 8.1.1) as its preferred alternative to meet national performance standards for impingement and entrainment losses. However, the NJDEP provided AmerGen another option should the closed-cycle alternative prove to be unavailable to OCNGS. This alternative is to move toward attainment of national performance standards by using design and construction technologies, operational measures, and/or restoration measures. The objective of the NJDEP's restoration requirement is to offset any residual impingement and entrainment losses from the OCNGS cooling system by increasing productivity elsewhere in the Barnegat Bay system. The description and impacts of this alternative are discussed in this section.

8.1.2.1 Description of the Modified Existing Once-Through Cooling System with Restoration Alternative

This alternative would reduce impingement and entrainment losses by retrofitting the existing system with improved technology, altering operations of the system, and restoring wetlands within Barnegat Bay to meet national performance standards that require (1) reduction in impingement mortality for all life stages of fish and shellfish by 80 to 95 percent from baseline conditions, and (2) reduction in entrainment for all life stages of fish and shellfish by 60 to 90 percent. In describing this alternative, the NJDEP provided little information regarding operational or design changes that might be employed at OCNGS to reduce impingement and entrainment losses.

The existing OCNGS once-through cooling system is described in Section 2.1.3. This system employs a Ristroph traveling screen system that reduces impingement losses by removing impinged organisms and returning them to the discharge canal, which then flows into Oyster Creek. The NJDEP evaluated various additional impingement-reduction technologies, including their technical feasibility, effectiveness, and costs, in the 1994 NJPDES permit for OCNGS. The alternative technologies that were identified to have the greatest potential to reduce impingement and entrainment at OCNGS were (1) replacing the existing 3/8-in. mesh traveling screens with fine-mesh screen panels; (2) retrofitting dilution-pump intakes with conventional 3/8-in. mesh or fine-mesh traveling screens; (3) retrofitting dilution-pump intakes with fine-mesh centerflow screens; and (4) replacing intakes with fine-mesh wedgewire screens. These options were eliminated from further consideration at OCNGS because they traded off reduced entrainment with increased impingement, or were impractical at the OCNGS site because of the high rate of biofouling or blockage. None of these systems are expected to further reduce losses by even 50 percent (Summers et al. 1989).

Other possible modifications to the system that might reduce impingement include utilizing a newer traveling screen design (e.g., a multidisc screen system), installation of an acoustic deterrent system for fish, and optimization of the existing fish-return system to reduce damage to fish. The effectiveness of these technologies or operational changes in reducing entrainment and impingement is uncertain. As stated above, none of these alternatives are expected to reduce losses by even 50 percent.

There are no feasible technologies for nuclear plants with once-through cooling that would substantially reduce entrainment without reducing flow through the plant. AmerGen could modify pumping rates or optimize dilution operations to reduce slightly entrainment losses for targeted species at certain times of the year when they are more susceptible to entrainment.

The NJDEP considers restoration of wetlands in Barnegat Bay to be a viable alternative to minimize the residual impacts of cooling-water systems after the implementation of design and operational modifications. These wetlands provide foraging habitat, provide shelter, serve as nursery areas for early life stages and juveniles of fish and shellfish, and contribute to the aquatic food base. An increase in wetlands in the Barnegat Bay watershed could support increased populations of those species affected by OCNGS cooling-system operations and, thus, offset entrainment and impingement losses of those species.

In the draft NJPDES permit for OCNGS, the NJDEP estimated that a significant amount of wetlands would need to be restored to offset impingement and entrainment losses at OCNGS, but recognized that additional study would be needed before a final restoration requirement was determined. In the interim, the NJDEP indicated that it would require AmerGen to initiate a wetlands restoration and enhancement program of a minimum of 350 ac within the Barnegat Bay estuary (and possibly on the Finninger Farm portion of the OCNGS site) as soon as possible.

The NJDEP identified 103 high-priority sites within the Barnegat Bay watershed that could be considered by AmerGen for restoration. The NJDEP also offered methods to implement restoration and focused on options identified in the Barnegat Bay National Estuary Program (BBNEP) *Comprehensive Conservation and Management Plan* (BBNEP 2002), including:

- Protect and improve vegetated buffer zones adjacent to coastal wetlands and freshwater tributaries to maintain continuous riparian corridors for habitat protection and low-impact recreational pursuits,

- Control erosion in threatened shoreline areas, and

- Manage tidal wetlands to preserve unditched wetlands and to rehabilitate wetlands that have been ditched or otherwise altered.

Wetland restoration activities as applied to the mitigation of cooling-water intake structure impacts were described by Hlohowskyj et al. (2003). In general terms, any wetland restoration project requires a number of actions that result in short-term disturbance but long-term benefits. Initial restoration activities typically include (1) establishment of the required hydrologic regime, (2) soil and site preparation, and (3) planting. Hydrologic modification of a site can include installation of structures that control the inflow and outflow of water, the removal of dikes or berms that prevent flooding, the removal of drainage tiles or ditches that drain water away from a site, and the creation of channels or basins. Soil preparation could include grading and recontouring, removal of contaminated sediments, or replacement of sediments. Whenever possible, the original wetland soils are salvaged and used in the restored wetland. Restoration often requires the removal of invasive non-native plant species (e.g., common reed and purple loosestrife [*Lythrum salicaria*]) through the use of herbicides (e.g., glyphosate), prescribed burning, biocontrol, or a combination of techniques. Following the removal of invasive species, the planting of native wetland and upland species along a hydrologic gradient is often required.

Once initial restoration activities are complete, restored wetlands usually require periodic maintenance such as prescribed burning, herbicide application, and planting to maintain the desired mix of native plant species. These activities could be required throughout the license renewal period.

8.1.2.2 Environmental Impacts of the Modified Existing Once-Through Cooling System with Restoration Alternative

This section discusses the impacts that would occur if AmerGen modified its existing once-through cooling system and undertook a wetland restoration program to offset impacts of the existing system on aquatic ecology. Because of the lack of viable retrofit technology to further reduce impingement and entrainment, there would be little change in the current impacts associated with continued operation of the existing cooling system. As presented in Sections 4.1, 4.6, and 4.8, the impacts of continued operation of the existing system would be SMALL. Wetland restoration would result in short-term adverse impacts on some resources, but is expected to produce long-term benefits. Anticipated impacts of this alternative also are summarized in Table 8-1.

- **Land Use**

  Modification of the existing once-through cooling system at OCNGS is not likely to require any new land; the majority of modification would take place on land currently occupied by OCNGS facilities. Temporary storage and laydown areas would likely use existing storage areas, parking lots, and other previously disturbed areas. At least some restoration of wetlands could occur on the OCNGS site, especially on the Finninger Farm portion of the site. This part of the site is mostly undisturbed and not currently used for operations. Restoration of lands on this portion of the site would not constitute a change in land use.

The NRC staff concludes that the impact on onsite land use of modifying the existing once-through cooling system at the OCNGS site would be SMALL, with no new land required.

The modification of the existing once-through cooling system with restoration alternative could result in land-use changes offsite. It is estimated that the restoration of wetlands to compensate for OCNGS impacts could require acquisition of substantial amounts of land within the Barnegat Bay watershed (NJDEP 2005). The exact acreage and location of lands to be designated in the restoration program are not known, but land acquisition is likely to proceed incrementally.

Modifications to the cooling system are likely to employ a small number of workers, with no new workers likely to be required once modifications are complete (AmerGen 2006). During modification, a small number of additional jobs would be created indirectly in the economy of the surrounding region. Compared with total employment in the economy surrounding the plant, increases in direct and indirect employment in the region would be small and would have no effect on land use.

Modification of the existing cooling system at the site would increase the value of OCNGS property, producing a small increase in property tax revenues for Lacey and Ocean Townships during plant operation. Compared with the existing property tax base, however, increases in property taxes as a result of the modifications are likely to be small and not likely to produce any impacts on offsite land use.

Changes in land designation under the restoration program could have an impact on land use in the Barnegat Bay area, depending on the location of specific land parcels and the pace of restoration. Depending on the location and size of the area to be restored, the impact on offsite land use could range from SMALL to MODERATE. Overall, the NRC staff concludes that the impact on offsite land use of the modification of the existing cooling system with restoration alternative at OCNGS would be SMALL to MODERATE.

- **Ecology**

Aquatic Ecology. Because extensive plant modifications are not anticipated under this alternative, onsite construction-related impacts are expected to be minimal. During restoration activities, short-term impacts could occur if modifications to nearshore areas are required to reestablish hydraulic connectivity. These impacts could include the removal of dikes or other nearshore obstructions, dredging or filling activities, and restoration actions associated with upland sites that influence adjacent nearshore environments. Potential nearshore impacts include increased turbidity, changes in nutrient or dissolved oxygen concentrations in the water, short-term impacts associated with changes to current patterns, water temperature, and salinity. It is likely that the impacts associated with these activities can be reduced through the use of silt fences or other physical barriers, or by timing construction activities to occur when the least amount of impact on important resources is expected.

Entrainment impacts associated with modifications to the existing once-through cooling system would be expected to be somewhat smaller than those identified in Section 4.1.1 of this SEIS. The overall impacts associated with entrainment could be reduced somewhat if flow reductions or plant shutdowns are employed during the spring and early summer when the eggs and larvae of many species are present in the water column. Based on the 316(b) evaluation conducted by EA (1986), the organisms most commonly entrained include juvenile and adult opossum shrimp (*Neomysis integer*), hard clam (*Mercenaria mercenaria*) larvae, sand shrimp (*Crangon septemspinosa*) zoea, and eggs or early developmental stages of other species (Table 4-3).

Impingement impacts associated with modifications to the existing system would be expected to be smaller than those currently identified in Section 4.1.2 of this SEIS. It may be possible, however, to reduce slightly the overall impingement rates through flow reductions during periods when organisms susceptible to impingement are present in or near the intake canal. It might also be possible to increase survivorship of individuals once impinged through physical and operational changes to the screen wash system. Based on the 316(b) evaluation conducted by EA (1986), the organisms most commonly impinged include sand shrimp, blue crab (*Callinectes sapidus*), and bay anchovy (*Anchoa mitchilli*) (Table 4-5).

The current NPDES permit prohibits OCNGS from scheduling routine shutdowns during the months of December through March to reduce the possibility of cold shock. OCNGS is also prohibited from scheduling routine maintenance that would result in a violation of thermal limitations during the months of June through September. With modifications of the existing once-through cooling system, the extent and magnitude of the thermal plume may be reduced during specific times of the year if additional flow reductions or shutdowns are scheduled to reduce further the thermal, entrainment, or impingement impacts associated with plant operation.

As discussed above, it is not possible to determine the overall impacts or positive environmental benefits of restoration until (1) the site or sites are identified, (2) the goals for the restoration are clearly stated, (3) a detailed restoration and monitoring plan is developed, (4) the restoration is initiated, and (5) the success of the restoration is evaluated based on the results of long-term monitoring. Although the overall goals of the restoration program may vary by site, it is assumed that the programs would be designed to improve the estuarine food webs adversely affected by entrainment or impingement, and to mitigate impingement losses. Based on the information provided by the NJDEP (NJDEP 2005), the largest impacts of OCNGS operations appear to be associated with the loss of opossum shrimp, sand shrimp, hard clam, bay anchovy, winter flounder (*Pseudopleuronectes americanus*), and blue crab due to entrainment or impingement impacts. It is assumed that restoration activities would be employed to mitigate the losses of these and other species as well.

The NRC staff concludes that the impacts on aquatic ecology of modifying and operating the once-through cooling system at OCNGS would continue to be SMALL as described in Sections 4.1.1, 4.1.2, and 4.1.3 of this SEIS. Slight reductions in impacts could occur as a result of modifying the existing system. The adverse impacts of initial restoration activities on aquatic ecology could range from SMALL to MODERATE. It is expected, over time, that the impacts will ultimately be SMALL and the estuary will benefit from the restoration activities.

<u>Terrestrial Ecology</u>. The restoration of wetlands would potentially increase wildlife diversity and provide high-quality foraging and nesting habitat for wildlife, especially birds. Some short-term, localized impacts on ecological resources could occur during the initial stages of wetland restoration (e.g., habitat disruption and disturbance of wildlife). These would occur from the need to (1) establish the hydrologic regime (e.g., install water-flow control structures, remove dikes or berms, remove drainage tiles or ditches, and create channels or basins), (2) prepare the soil (e.g., grading and recontouring, removal of contaminated sediments, or replacement of sediments), and (3) planting of native wetland and upland species (Hlohowskyj et al. 2003). Prior to planting, there may be the need to remove invasive non-native plant species through the use of herbicides, prescribed burns, and/or biocontrol. Also, periodic maintenance (e.g., prescribed burns, herbicide application, and additional plantings) could be required to maintain the desired mix of native plant species (Hlohowskyj et al. 2003). This would cause short-term impacts similar to those that would occur during wetland restoration.

The NRC staff concludes that the adverse impact on terrestrial ecology of wetland restoration would be SMALL to MODERATE in the short-term, but would be SMALL over the long-term. Short-term adverse terrestrial ecological impacts would occur during initial wetland restoration and periodic maintenance activities. However, restoring wetland areas could provide long-term benefits to the Barnegat Bay estuary.

- **Water Use and Quality**

Possible modifications to the operation of the existing once-through cooling system would not significantly affect usage or quality of surface water or groundwater.

During initial restoration activities, temporary impacts on surface water could result from the erosion of exposed and excavated soils. This erosion could be a significant source of turbidity to adjacent surface waters, but the impact level would depend on factors such as soil characteristics, slope, and the area of land affected. The land-use history of the areas to be restored could affect the potential impact on surface water, since soil contaminated from past industrial practices could become exposed. Use of best management practices to control erosion would prevent most impacts related to ground disturbance. Periodic maintenance of restored wetlands would not be expected to have an adverse impact on water resources, because little land disturbance would be expected, and herbicide use and prescribed burning would be conducted by qualified licensed applicators.

On the basis of these considerations, the NRC staff concludes that the impact of the modified existing once-through cooling system with restoration alternative on surface-water and groundwater use and quality would be SMALL.

- **Air Quality**

Relatively minor construction-related impacts are anticipated with the modified existing once-through cooling system with restoration alternative. Modifications to the existing cooling system are not expected to require extensive construction activities or ground disturbance, and operation of the system would not produce a change in emissions from those produced by operation of the existing system as described in Section 2.2.4 of this SEIS. Because wetland restoration activities could include grading and excavation of soils, use of earthmoving equipment could generate some fugitive dust and engine exhaust. Air quality impacts of these activities are expected to be minimal and would not result in exceedance of national or State standards for criteria pollutants.

The application of herbicides to remove invasive, non-native plant species would be conducted by licensed applicators using methods that would reduce or eliminate drift. Controlled applications, in the absence of high winds, should minimize the unintended spread of herbicides to downwind offsite locations. Prescribed burning would generate some smoke over short periods, but burns would be performed under controlled conditions to minimize offsite impacts.

The NRC staff considers the air quality impacts of the modified existing once-through cooling system with restoration alternative to be SMALL.

- **Waste**

Modification of the existing once-through cooling system could generate small amounts of waste related to cooling-system modifications. Little, if any, ground-disturbing activities and associated waste are expected to be needed for system modification. Any waste materials generated would be recycled or disposed of properly offsite. Operation of the system is not expected to generate significant amounts of waste.

Restoration activities could produce some waste, including removed plant materials, excavated soils, dredged sediments, potentially contaminated soils, and other materials that must be removed from the area to be restored. The amount of waste involved would depend on the size and location of the area to be restored and site-specific conditions that cannot be determined until a specific restoration plan has been developed and approved. It is unlikely that restoration-related wastes would pose a significant problem.

On the basis of these considerations, the NRC staff concludes that waste-related impacts associated with the modified existing once-through cooling system with restoration alternative would be SMALL.

- **Human Health**

Construction activities associated with the modified existing once-through cooling system with restoration alternative are expected to be less extensive than under the closed-cycle cooling-tower system alternative. As described in Section 8.1.2.1, possible plant modifications include modification of intake structures, pumping rates, and optimization of dilution pump operations to reduce entrainment and impingement losses for targeted species. Consequently, human health impacts associated with cooling-system modifications are expected to be SMALL.

Restoration of wetlands could include activities such as installation of structures that control the inflow and outflow of water, the removal of dikes or berms that prevent flooding, the removal of drainage tiles or ditches that drain water away from a site, and the creation of channels or basins. These activities could include the use of heavy construction equipment. During such activities, there would be a relatively slight risk to workers from typical construction incidents and accidents. However, the occurrence of such events would be mitigated by the use of proper industrial hygiene practices, worker safety requirements, and training.

The restoration of wetlands would also likely involve the use of herbicides, prescribed burning, biocontrol, or a combination of techniques. These activities also pose a potential risk to human health, primarily to those directly involved in the activity. Human health risks associated with these activities would be mitigated by the use of licensed applicators and the use of proper industrial hygiene practices, worker safety requirements, and training.

Overall, human health impacts associated with activities for this alternative are expected to be SMALL.

- **Socioeconomics**

Cooling-system modification and restoration activities are likely to employ a small number of workers. A small number of additional jobs could be created indirectly in the economy of the surrounding region. Compared with total employment in the region, increases in direct and indirect employment would be small. Additionally, as few of the additional workers are likely to migrate into the area from elsewhere, the projected small increase in employment would not affect housing and public services. Increases in traffic associated with the increase in plant employment on U.S. Highway 9 would also be SMALL. No additional permanent employees are likely to be needed to operate the modified system or maintain restored areas.

Changes in land designation under the restoration program could have an impact on property values, employment, and tax revenues in the Barnegat Bay area. The level of impact would depend on the location, size, and characteristics of the area to be restored.

The NRC staff concludes that the impact of the modification of the existing once-through cooling system with restoration alternative on socioeconomics would be SMALL.

- **Aesthetics**

Construction activities associated with the modification of the existing cooling system at OCNGS could have an impact on the visual environment and on noise if these modifications change the visual character at the power plant location, or if construction activities markedly add to local noise levels. The site currently hosts a number of large industrial buildings, and because many of the cooling-system modifications are likely to be associated with existing structures, modifications to the plant are not expected to change the character of the local visual environment. Construction activities would likely produce low levels of noise associated with the operation of construction machinery and construction traffic entering and leaving the site. Operations of the modified system are not expected to change noise levels on or off the OCNGS site.

Restoration activities could produce short-term impacts on visual aesthetics until initial restoration activities were complete. Once restored wetlands are established, long-term benefits are anticipated.

The NRC staff concludes that the impact of the modified existing once-through cooling system with restoration alternative on visual aesthetics and noise would be SMALL.

- **Historic and Archaeological Resources**

The OCNGS site has not been surveyed for historic and archaeological resources, and the potential exists for resources to be present within the site boundaries. However, modification of the existing once-through cooling system would not require new land disturbance and would not require an archaeological survey within the site. No impacts on historic and archaeological resources are anticipated from construction or operation of the modified once-through cooling system.

Archaeological surveys to identify and evaluate historic and archaeological resources in areas identified for restoration would be required prior to initiation of ground disturbing activities. The archaeological surveys would have to be conducted by qualified archaeologists in consultation with the New Jersey SHPO and appropriate Native American Tribes, as required under Section 106 of the NHPA. Many shell midden sites occur adjacent to wetland areas, and such sites may be encountered during surveys. Sites that are determined to be eligible would require mitigation prior to initiating restoration actions. Mitigation, including avoidance, data recovery, or other options, would be determined in consultation with the SHPO and Native American Tribes. The impact of restoration on historic and archaeological resources could range from SMALL to MODERATE, depending on the locations chosen for restoration, the number of sites recorded in those locations, whether the recorded sites are significant (i.e., eligible for listing on the NRHP), and the ability to avoid or mitigate significant sites through data recovery or other means.

- **Environmental Justice**

Modification to the existing once-through cooling system at OCNGS and restoration of wetlands could have an impact on environmental justice if environmental impacts of modifications affected minority and low-income populations in a disproportionately high and adverse manner.

Based on staff guidance (NRC 2004), air, land, and water resources within 50 mi of the OCNGS site were examined. Within that area, a few potential environmental impacts could affect human populations; all of these would be considered SMALL for the general population. The staff found no unusual resource dependencies or practices on land that would be a candidate for restoration, such as subsistence agriculture, hunting, or fishing, through which minority and low-income populations could be disproportionately highly and adversely affected. The NRC staff concludes that the environmental justice impacts of the modified existing once-through cooling system with restoration alternative are expected to be SMALL.

8.2 No-Action Alternative

NRC regulations implementing the National Environmental Policy Act (NEPA), 10 CFR Part 51, Subpart A, Appendix A(4), specify that the no-action alternative be discussed in an NRC EIS. For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OCNGS OL, and AmerGen would then cease plant operations by the end of the current OL and initiate decommissioning of the plant. AmerGen eventually would be required to shut down OCNGS and to comply with NRC decommissioning requirements in 10 CFR 50.82, whether or not the OL is renewed. If the OCNGS OL is renewed, shutdown of the unit and decommissioning activities would not be avoided, but would be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning under a license renewal or the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the license renewal GEIS (NRC 1996), Chapter 7 of this SEIS, and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those that would occur after 40 years of operation.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1.[a] Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts would occur when the unit shuts down regardless of whether the license is renewed or not and are discussed below, with the results presented in Table 8-2. Plant shutdown would result in a net reduction in power production capacity. The power not generated by OCNGS during the license renewal term would likely be replaced by (1) power purchased from other electricity providers, (2) generation alternatives other than OCNGS, (3) demand-side management (DSM) and energy conservation, or (4) some combination of these options. The environmental impacts of these options are discussed in Section 8.3.

- **Land Use**

  In Chapter 4, the NRC staff concluded that the impact of continued plant operation on land use would be SMALL. Onsite land use would not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission line associated with the project is expected to remain

(a) Appendix J of NUREG-0586, Supplement 1, discusses the socioeconomic impacts of plant closure. The results of the analysis in Appendix J, however, were not incorporated into the analysis presented in the main body of the NUREG.

in service after the plant stops operating. As a result, maintenance of the transmission line right-of-way will continue as before. Therefore, the NRC staff concludes that the impact on land use from plant shutdown would be SMALL.

- **Ecology**

In Chapter 4, the NRC staff concluded that the ecological impact of continued plant operation would be SMALL. Cessation of operations would be accompanied by a reduction in cooling-water flow and in the extent of the thermal plume from the plant. These changes would reduce environmental impacts on aquatic species, including threatened and endangered sea turtles. The transmission line associated with OCNGS is expected to remain in service after OCNGS stops operating. As a result, maintenance of the right-of-way and subsequent impacts on the terrestrial ecosystem would continue as before. Therefore, the NRC staff concludes that the ecological impact from shutdown of the plant would be SMALL.

- **Water Use and Quality – Surface Water**

In Chapter 4, the NRC staff concluded that the impact of continued plant operation on surface-water use and quality would be SMALL. When the plant stops operating, there would be an immediate reduction in the consumptive use of water because of the reduction in cooling-water flow and in the amount of heat rejected to Barnegat Bay. The effects of operations on flow and salinity in Oyster Creek and the Forked River would also cease, and flow and salinity conditions more similar to preoperational conditions would be expected to become established. Therefore, the NRC staff concludes that the impact on surface-water use and quality from plant shutdown would be SMALL.

- **Water Use and Quality – Groundwater**

In Chapter 4, the NRC staff concluded that the impact of continued plant groundwater use on groundwater availability and quality would be SMALL. When the plant stops operating, there would be a reduction in the use of well water because reactor makeup water would no longer be required and there would be reduced potable water consumption and sanitary use as the size of the plant staff decreases. Therefore, the NRC staff concludes that the impact on groundwater use and quality from shutdown of the plant would be SMALL.

- **Air Quality**

In Chapter 4, the NRC staff concluded that the impact of continued plant operation on air quality would be SMALL. When the plant stops operating, there would be a reduction in emissions from activities related to plant operation, such as the use of diesel generators and worker transportation. Therefore, the NRC staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

The impacts of radioactive waste generated by continued plant operation are discussed in Chapter 6. The impact of low-level and mixed waste from plant operation is characterized as SMALL. When OCNGS stops operating, it would stop generating high-level waste (HLW), and the generation of low-level and mixed waste associated with plant operation and maintenance would be reduced. Therefore, the NRC staff concludes that the impact of waste generated after shutdown of the plant would be SMALL.

- **Human Health**

In Chapter 4, the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL. After the cessation of operations, the amount of radioactive material released to the environment in gaseous and liquid forms would be reduced. Therefore, the NRC staff concludes that the impact of shutdown of the plant on human health would be SMALL. In Chapter 5, the NRC staff concluded that the impacts of accidents during operation would be SMALL. After shutdown, the variety of potential accidents at the plant would be reduced to a limited set associated with fuel handling and storage. Therefore, the NRC staff concludes that the impact of potential accidents following shutdown of the plant would be SMALL.

- **Socioeconomics**

In Chapter 4, the NRC staff concluded that the socioeconomic impact of continued plant operation would be SMALL. There would be immediate socioeconomic impacts associated with the shutdown of the plant because of the reduction in the staff at the plant. There may also be an immediate reduction in property tax revenues for Ocean County, but this is anticipated to be small. The overall impact would depend on the state of the economy, the net change in workforce at the plant, and the changes in local government tax receipts. Appendix J of Supplement 1 to NUREG-0586 (NRC 2002) shows that the overall socioeconomic impact of plant closure plus decommissioning could be greater than SMALL. However, the NRC staff concludes that the socioeconomic impact of OCNGS shutdown would be SMALL because of the relatively small employment loss compared with total employment in the economy of the surrounding area. Impacts also could be offset if new power-generating facilities are built at or near the current site.

Table 8-2. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Land use	SMALL	Impact is expected to be SMALL because plant shutdown would not be expected to result in changes to onsite or offsite land use.
Ecology	SMALL	Impact is expected to be SMALL because aquatic impacts would be reduced from current levels, and terrestrial impacts are not expected because there would not be any changes in transmission line right-of-way maintenance practices.
Water use and quality – surface water	SMALL	Impact is expected to be SMALL because surface-water intake and discharges would be eliminated.
Water use and quality – groundwater	SMALL	Impact is expected to be SMALL because groundwater use would decrease.
Air quality	SMALL	Impact is expected to be SMALL because emissions related to plant operation and worker transportation would decrease.
Waste	SMALL	Impact is expected to be SMALL because generation of high-level waste would stop, and generation of low-level and mixed waste would decrease.
Human health	SMALL	Impact is expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, would be further reduced.
Socioeconomics	SMALL	Impact is expected to be SMALL because the loss of overall employment and tax revenues would be small.
Transportation	SMALL	Impact is expected to be SMALL because the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impact is expected to be SMALL because plant structures would remain in place.
Historic and archaeological resources	SMALL	Impact is expected to be SMALL because shutdown of the plant would not result in land disturbance.
Environmental justice	SMALL	Impact is expected to be SMALL because the loss of overall employment would be small.

- **Transportation**

In Chapter 4, the NRC staff concluded that the impact of continued plant operation on transportation would be SMALL. Cessation of operations would be accompanied by a reduction of traffic in the vicinity of the plant. Most of the reduction would be associated with a reduction in the plant workforce, but there also would be a reduction in shipment of material to and from the plant. Therefore, the NRC staff concludes that the impact of plant closure on transportation would be SMALL.

- **Aesthetics**

  In Chapter 4, the NRC staff concluded that the aesthetic impact of continued plant operation would be SMALL. Plant structures and other facilities are likely to remain in place until decommissioning. Therefore, the NRC staff concludes that the aesthetic impact of plant closure would be SMALL.

- **Historic and Archaeological Resources**

  In Chapter 4, the NRC staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. Onsite land use would not be affected immediately by the cessation of operations. Plant structures and other facilities would likely remain in place until decommissioning. The transmission line associated with the project is expected to remain in service after the plant stops operating. As a result, maintenance of the transmission line right-of-way would continue as before. Therefore, the NRC staff concludes that the impact on historic and archaeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

  In Chapter 4, the NRC staff concluded that the environmental justice impact of continued operation of the plant would be SMALL. Continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. Shutdown of the plant also would not have disproportionately high and adverse impacts on minority and low-income populations resulting from the loss of employment opportunities at the site or from secondary socioeconomic impacts (e.g., loss of patronage at local businesses because the loss would be very minor in the context of the regional economy). The NRC staff concludes that the environmental justice impact of plant shutdown is expected to be SMALL. Any impact would be offset if new power-generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of this impact.

8.3 Alternative Energy Sources

This section discusses the environmental impacts associated with developing alternative sources of electric power to replace the power generated by OCNGS, assuming that the OL for OCNGS is not renewed. The order of presentation of alternative energy sources does not imply which alternative would be most likely to occur or to have the least environmental impacts.

The following power-generation alternatives are considered in detail:

- Coal-fired plant generation at the OCNGS site and at an alternate site (Section 8.3.1),

- Natural-gas-fired plant generation at the OCNGS site and at an alternate site (Section 8.3.2), and

- New nuclear power plant generation at the OCNGS site and at an alternate site (Section 8.3.3).

The alternative of purchasing power from other sources to replace power generated at OCNGS is discussed in Section 8.3.4. Other power-generation alternatives and conservation alternatives considered by the NRC staff and found not to be reasonable replacements for OCNGS are discussed in Section 8.3.5. Section 8.3.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its *Annual Energy Outlook 2005 with Projections to 2025*, the EIA projects that more than 60 percent of new electric-generating capacity between 2004 and 2025 will be accounted for by combined-cycle,[a] distributed generation, or combustion turbine technology fueled by natural gas (EIA 2005). These technologies are designed primarily to supply peak and intermediate capacity; combined-cycle technology, however, can also be used to meet baseload[b] requirements. The EIA projects that coal-fired plants will account for nearly 33 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, biomass, and geothermal, are projected by the EIA to account for the remaining 5 percent of new capacity. The EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. The EIA projects that combined-cycle plants will have the lowest levelized electricity costs for new plants in 2015, followed by wind generation and then coal-fired plants (EIA 2005). By 2025, coal-fired plants are projected to have the lowest costs, followed by gas combined-cycle plants and wind generation (EIA 2005).

(a) In a combined-cycle unit, hot combustion gas in a combustion turbine rotates the turbine to generate electricity. The hot exhaust from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

(b) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; that is, these units generally run near full load.

The EIA projects that oil-fired plants will account for very little new generation capacity in the United States between 2004 and 2025 because of higher fuel costs and lower efficiencies (EIA 2005).

The EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States between 2004 and 2025 because natural gas and coal-fired plants are projected to be more economical (EIA 2005). However, there has been an increased interest in constructing new nuclear power facilities, as evidenced by the certification of four standard nuclear power plant designs and recent activities involving the review of other plant designs and potential sites (see Section 8.3.3). The NRC has also established a new reactor licensing program organization to prepare for and manage future reactor and site licensing applications (NRC 2001). In addition, the Energy Policy Act of 2005 (EPACT) contains provisions to ensure that nuclear energy continues to be a major component of the nation's energy supply. This Act also establishes a production tax credit for new nuclear power facilities. Therefore, despite the EIA projection, a new nuclear plant alternative for replacing power generated by OCNGS is considered in this SEIS.

OCNGS has a net electrical capacity of 640 MW(e) (Section 2.1.2; AmerGen 2005). For the coal- and natural-gas-fired plant alternatives, the NRC staff assumed construction of a 600-MW(e) plant, which is consistent with AmerGen's Environmental Report (ER) (AmerGen 2005). This assumption will understate the environmental impacts of replacing the 640 MW(e) from OCNGS by about 7 percent. The applicant did not identify any specific alternate sites in the ER for the coal-fired or natural-gas-fired plants; however, it was assumed that a suitable location could be found in the region. For the new nuclear power plant alternative, the NRC staff assumed the same capacity as OCNGS. Therefore, this SEIS evaluates both the OCNGS site and an alternate site for the analysis of environmental impacts for the new nuclear power plant alternative.

8.3.1 Coal-Fired Plant Generation

The coal-fired plant alternative is analyzed for a generic alternate site. Unless otherwise indicated, the assumptions and numerical values used are from the AmerGen ER (AmerGen 2005). The NRC staff reviewed the information in the AmerGen ER and compared it with environmental impact information in the GEIS for license renewal. Although the OL renewal period is only 20 years, the impact of operating a coal-fired plant for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant). The NRC staff assumed that the OCNGS plant would remain in operation while the alternative coal-fired plant was constructed.

The NRC staff assumed the construction of one standard 600-MW(e) unit for a total capacity of 600 MW(e) as a potential replacement for OCNGS. The coal-fired plant would consume approximately 1.9 million tons/yr of pulverized bituminous coal with an ash content of approximately 9.5 percent (AmerGen 2005). AmerGen assumes a heat rate[(a)] of 10,200 Btu/kWh and a capacity factor[(b)] of 0.85 in its ER (AmerGen 2005).

In addition to the impacts discussed below for a coal-fired plant at an alternate site, impacts would occur offsite as a result of the mining of coal and limestone. Impacts of mining operations would include an increase in fugitive dust emissions; surface-water runoff; erosion; sedimentation; changes in water quality; disturbance of vegetation and wildlife; disturbance of historic and archaeological resources; changes in land use; and impacts on employment.

The magnitude of these offsite impacts would largely be proportional to the amount of land affected by mining operations. In the GEIS, the NRC staff estimated that approximately 22,000 ac would be affected by the mining of coal and the disposal of the waste needed to support a 1000-MW(e) coal-fired plant during its operational life (NRC 1996). Proportionally less land would be affected by a 600-MW(e) plant. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for OCNGS. In the GEIS, the NRC staff estimated that approximately 1000 ac would be affected for mining the uranium and processing it during the operating life of a nuclear power plant.

8.3.1.1 Coal-Fired Plant with a Closed-Cycle Cooling System

In this section, the NRC staff evaluates the impacts of a coal-fired plant located at OCNGS and at an alternate site that uses a closed-cycle cooling system. The impacts of a coal-fired plant using a once-through cooling system are considered in Section 8.3.1.2 of this SEIS.

The overall impacts of the coal-fired plant alternative are discussed in the following sections and summarized in Table 8-3. The magnitude of impacts for an alternate site would depend on the characteristics of the particular site selected.

- **Land Use**

  For siting a coal-fired plant at OCNGS, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction and land disturbance that would be required. Specifically, the NRC staff assumed that a coal-fired plant at OCNGS would use the existing switchyard, offices, parking areas, and transmission line right-of-way. Land that has been previously disturbed would be used to the extent practicable.

(a) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btus) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of the fuel burned for electric generation by the resulting kWh generation.

(b) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

In its ER, AmerGen estimated that 524 ac of land would be needed for construction of a coal-fired plant at OCNGS. This estimate includes 171 ac for power block and coal storage, 180 ac for a new rail spur, and 173 ac for waste disposal (AmerGen 2005).[a] AmerGen assumed use of the existing once-through cooling system for a coal-fired plant at the OCNGS site; the NRC staff, however, evaluated closed-cycle cooling (see Section 8.3.1.2 and Table 8-3 of this SEIS for a discussion of the impacts of a coal-fired plant using a once-through cooling system). Additional land would likely be required for construction of cooling towers.

The GEIS estimates that approximately 1700 ac would be needed for a 1000-MW(e) coal-fired plant (NRC 1996). This estimate would be scaled down for the 600-MW(e) capacity of the proposed coal-fired plant alternative (i.e., 1020 ac) at an alternate site. Additional land might be needed for transmission lines and rail spurs, depending on the location of the alternate site relative to the nearest intertie connection and rail line.

Approximately 180 ac would be needed for a rail spur connection from Toms River, New Jersey, to OCNGS, assuming a 100-ft-wide corridor and approximately 15 mi of rail. Similar acreage would be needed for a rail spur if an alternate site is located within 15 mi of the nearest railway connection. Additional land would likely be needed at an alternate site for a transmission line to connect to the existing grid.

The waste produced by the coal-fired plant would be disposed of onsite either at OCNGS or at an alternate site, and would account for approximately 173 ac of land area over the 40-year plant life.

The NRC staff concludes that at OCNGS, the impact on land use of a coal-fired plant with a closed-cycle cooling system would be SMALL to LARGE, depending on the amount of previously disturbed lands that would be developed. This alternative would also result in MODERATE to LARGE land-use impacts at an alternate site, depending particularly on the location and length of the transmission line and rail spur.

- **Ecology**

Locating a coal-fired plant at OCNGS would impact ecological resources because of the need for more than 524 ac of land for power block construction, coal storage, waste disposal, rail spur construction, and cooling-tower construction. This land requirement includes both developed and undeveloped land at the OCNGS site.

(a) The amount of land needed for waste disposal during 20 years of operation (the length of the OCNGS license renewal period) is half of the 173 ac presented here; 173 ac is the area needed for 40 years of operation – the typical life of a coal-fired plant.

Table 8-3. Summary of Environmental Impacts of a Coal-Fired Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	SMALL to LARGE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses approximately 524 ac for power block, waste disposal, and rail spur; additional land would be needed for cooling-tower construction. Additional offsite land-use impacts from coal and limestone mining.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses approximately 1020 ac for plant, offices, parking, and waste disposal. Additional land (amount dependent on site chosen) would be needed for a rail spur and a transmission line. Same offsite impacts for mining as for a coal-fired plant at the OCNGS site.
Ecology	SMALL to LARGE	Impact would depend on the characteristics of land to be developed. Uses developed and undeveloped areas at current OCNGS site, plus undeveloped land offsite for rail spur. Impact on terrestrial ecology from cooling-tower drift is expected. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission line and rail spur routes. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the aquifers.

Table 8-3. (contd)

Impact Category	OCNGS Site Impact	OCNGS Site Comments	Alternate Site Impact	Alternate Site Comments
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the aquifers.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be MODERATE. Impact of operations on air quality during operations would be MODERATE with the following emissions expected: Sulfur oxides • 2796 tons/yr Nitrogen oxides • 469 tons/yr Particulates • 89 tons/yr of total suspended particulates • 20 tons/yr of PM_{10} Carbon monoxide • 469 tons/yr Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium.	MODERATE	Potentially the same impact as a coal-fired plant at the OCNGS site, although pollution-control standards may vary, depending on location. Impact during construction would be SMALL. Impact during operation would be MODERATE.
Waste	MODERATE	Waste would be generated and removed during construction. During operation, total waste volume would be about 331,000 tons/yr of ash and scrubber sludge, requiring approximately 173 ac for disposal during the 40-year life of the plant.	MODERATE	Same impact as a coal-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Impact is uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Same impact as a coal-fired plant at the OCNGS site.

Table 8-3. (contd)

	Impact Category	OCNGS Site		Alternate Site	
		Impact	Comments	Impact	Comments
1	Human health	SMALL	Impact is uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Same impact as a coal-fired plant at the OCNGS site.
2	Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 400 workers during the peak period of the 5-year construction period, followed by a reduction in the current OCNGS workforce of 470 to 170 workers; tax base preserved. Impact during operation would be SMALL.	SMALL to LARGE	Construction impact would depend on location, but could be LARGE if the plant is located in a rural area. Up to 400 workers during the peak period of the 5-year construction period. Operation would result in a workforce of 170 full-time employees, which is a net loss of approximately 300 jobs, if the site is located in Ocean County. Ocean County's tax base would experience a loss and an additional reduction in employment if the alternate site is not located within the county. Employment impacts could be offset by other economic growth in the area.
3	Transportation	MODERATE to LARGE	Transportation impact associated with construction would be MODERATE, as 470 OCNGS workers and 400 construction workers would be commuting to the site. Impact during operation would be SMALL, as the workforce would be reduced to 170 workers. For rail transportation of coal and lime over a distance of 15 mi, the impact is considered MODERATE to LARGE.	MODERATE to LARGE	Transportation impact associated with 400 construction workers would be MODERATE. Impact associated with 170 plant workers during operation would be SMALL. For rail transportation of coal and lime, the impact is considered SMALL to LARGE, depending on location.

Table 8-3. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE	Aesthetic impact due to the addition of plant units, cooling towers, plume stacks, coal piles, and rail spur is considered MODERATE. Intermittent noise from construction, commuter traffic, and waste disposal; continuous noise from cooling towers and mechanical equipment; and rail transportation of coal and lime would result in MODERATE noise impacts.	MODERATE to LARGE	Impact would depend on the characteristics of the site, but would be similar to those for a coal-fired plant at the OCNGS site. The impact could range from MODERATE to LARGE. Additional impact would result from construction and operation of the new transmission line and rail spur. Depending on the location of the site chosen, this impact could be LARGE.
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of construction on cultural resources.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new plant construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impact on housing could occur during construction; loss of 300 operating jobs could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at the site.

Ecological impacts related to the development of previously disturbed land would be minimal. Development of previously undisturbed lands could result in impacts on threatened or endangered species, wildlife habitat destruction, habitat fragmentation, reduced productivity, and local reductions in biological diversity. The magnitude of these impacts would depend on the current ecological condition of the land. Cooling-tower drift could result in impacts on terrestrial ecology, especially nearby vegetation. The use of cooling towers to replace once-through cooling would reduce thermal discharge and the entrainment and impingement of aquatic organisms. The NRC staff concludes that the ecological impacts of a new coal-fired plant with a closed-cycle cooling system at the OCNGS site would be SMALL to LARGE, depending on the amount of previously disturbed land that is used.

Locating a coal-fired plant at an alternate site would result in construction and operational impacts. Approximately 1020 ac of land would be converted to industrial use. Even assuming siting at a previously disturbed area, the impacts would affect ecological resources. Impacts could include impacts on threatened and endangered species, wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could cause entrainment and impingement of fish and other aquatic organisms, and result in adverse impacts on aquatic resources. If needed, construction and maintenance of a transmission line and a rail spur also would have ecological impacts. There would be some additional impact on terrestrial ecology from drift from the cooling towers. Overall, the ecological impacts of constructing a coal-fired plant with a closed-cycle cooling system at an alternate site are considered to be MODERATE to LARGE and would probably be greater than those associated with construction of a coal-fired plant at the OCNGS site.

- **Water Use and Quality**

Surface Water. At the OCNGS site, replacement of the existing once-through cooling system with a closed-cycle system would result in a reduction in cooling-water demands. Plant discharge would consist of cooling-tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides. Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the NJDEP. There would be consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation may occur during construction. Impacts on water quality are possible offsite from coal mining operations. The NRC staff considers the impacts of a new coal-fired plant with a closed-cycle cooling system located at the OCNGS site on surface-water use and quality to be SMALL.

At an alternate site, the impact on surface-water use and quality would depend on the volume of water needed for cooling makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State of New Jersey. The impacts would be SMALL to MODERATE and dependent on the receiving body of water.

Groundwater. The OCNGS currently uses groundwater for both reactor makeup water and potable water, and it is assumed that groundwater would continue as the source of potable water if a coal-fired plant were constructed at the OCNGS site. Impacts on groundwater use and quality of a coal-fired plant with a closed-cycle cooling system at the OCNGS site would be SMALL. Impacts on groundwater use and quality of a coal-fired plant at an alternate site would be SMALL to MODERATE, depending on the volume of groundwater withdrawn and characteristics of the aquifer.

- **Air Quality**

The air quality impacts of coal-fired generation differ considerably from those of nuclear generation due to emissions of SO_x, NO_x, particulate matter, CO, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

A new coal-fired plant located in New Jersey would likely need a PSD permit and an operating permit under the CAA. The plant would need to comply with the new-source performance standards for such plants as set forth in 40 CFR Part 60, Subpart D(a). The standards establish limits for particulate matter and opacity (40 CFR 60.42[a]), SO_2 (40 CFR 60.43[a]), and NO_x (40 CFR 60.44[a]).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the CAA. Portions of New Jersey have been classified as attainment or unclassified for criteria pollutants (40 CFR 81.331). In the posted amendment to that classification, dated April 30, 2004, there are several instances of nonattainment for ozone, including Ocean County (EPA 2004b).

Section 169A of the CAA establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (*Federal Register*, Volume 64, page 35714 [64 FR 35714]; July 1, 1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Brigantine National Wildlife Refuge, located about 20 mi south of OCNGS, is a Class I area where visibility is an important value (40 CFR 81.414). Air quality in this area could be affected by a coal-fired plant at the OCNGS site and at an alternate site if the site chosen were located within 62 mi of the wildlife refuge.

In 1998, the EPA issued a rule requiring 20 eastern states, including New Jersey, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone (40 CFR 50.9).

The total amount of NO_x that can be emitted by each of the 20 states in the 2007 ozone season (May 1 to September 30) is presented in 40 CFR 51.121(e). For New Jersey, the amount is 330,836 tons/yr (EPA 2001).

Anticipated impacts for particular pollutants that would result from a coal-fired plant at the OCNGS site or at an alternate site are as follows:

Sulfur oxides. A new coal-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce SO_2 and NO_x emissions, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal-fired plant alternative than the proposed action.

AmerGen estimates that by using wet limestone flue gas desulfurization to minimize SO_x emissions (95 percent removal), the total annual stack emissions would be approximately 2796 tons of SO_x (AmerGen 2005).

Nitrogen oxides. Section 407 of the CAA establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new-source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain NO_x (expressed as nitrogen dioxide [NO_2]) in excess of 200 ng/J (1.6 lb/MWh) of gross energy output, based on a 30-day rolling average.

AmerGen estimates that by using NO_x burners with overfire air and selective catalytic reduction (SCR) (95 percent reduction), the total annual NO_x emissions for a new coal-fired power plant would be approximately 469 tons (AmerGen 2005). This level of NO_x emissions would be greater than under the proposed action.

Particulate matter. AmerGen estimates that the total annual stack emissions would include 89 tons of filterable total suspended particulates and 20 tons of particulate matter (PM_{10}) (40 CFR 50.6). Fabric filters (99.9 percent removal) would be used for control (AmerGen 2005). Particulate emissions would be greater under the coal-fired plant alternative than under the proposed action.

The construction of a coal-fired plant would generate fugitive dust. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide. AmerGen estimates that the total CO emissions would be approximately 469 tons/yr (AmerGen 2005). This level of emissions is greater than that under the proposed action.

Hazardous air pollutants, including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. The EPA found that coal-fired power plants emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between the burning of coal and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, on March 15, 2005, the EPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants (EPA 2005).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 ppm. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that in 1982, a typical coal-fired plant released about 5.2 tons of uranium and 12.8 tons of thorium (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide (CO_2) emissions that could contribute to global warming. The level of emissions from a coal-fired plant would be greater than that under the proposed action.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts could be substantial. The GEIS also mentioned global warming from unregulated CO_2 emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the products of coal combustion. The NRC staff concludes that appropriate characterization of air impacts from coal-fired generation at the OCNGS site would be MODERATE.

Siting a coal-fired power plant at an alternate site would not significantly change air quality impacts from those described for a coal-fired plant at the OCNGS site, although it could result in installing more or less stringent pollution control equipment to meet local applicable requirements. Therefore, the NRC staff concludes that the impact on air quality would be MODERATE.

- **Waste**

Waste would be generated during construction activities. During operations, coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. One 600-MW(e) coal-fired plant would generate approximately 331,000 tons of this waste annually for 40 years (AmerGen 2005). The ash and scrubber sludge would be disposed of onsite, accounting for approximately 173 ac of land area over the 40-year plant life. Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality; however, with appropriate management and monitoring, the impact is expected to be small to moderate. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, the EPA issued a “Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels” (EPA 2000b). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could be dangerous to human health and the environment under certain conditions; (2) the EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) the EPA identified gaps in State oversight of coal combustion wastes. Accordingly, the EPA announced its intention to issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act.

For all of the preceding reasons, the impact from waste generated from burning coal at either the OCNGS site or at an alternate site is considered MODERATE.

- **Human Health**

Worker risks associated with coal-fired plants result from fuel and limestone mining, from fuel and lime transportation, and from disposal of coal combustion waste. In addition, there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal-fired plant alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the NRC staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, establish air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, the EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, the NRC staff expects that the human health impact from radiological doses and inhalation of toxins and particulates generated by burning coal would be SMALL, whether at the OCNGS site or at an alternate site.

- **Socioeconomics**

Construction of a coal-fired plant and associated facilities would take approximately 5 years. The NRC staff assumed that construction would take place while OCNGS continues operation and would be completed by the time OCNGS permanently ceases operations. Estimates presented in the GEIS indicate that the workforce would be expected to vary between 720 and 1500 workers during the 5-year construction period for a 600-MW(e) coal-fired plant (NRC 1996). However, AmerGen estimates approximately 400 workers during the peak construction period. These workers would be in addition to the approximately 470 workers employed at OCNGS. During construction, the surrounding communities would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other nearby locations, including areas like Atlantic City, Newark, and Philadelphia. After construction, the local communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth currently being projected for the area. Impacts on socioeconomics of operation of a coal-fired plant would be SMALL.

Construction of a replacement coal-fired power plant at an alternate site would impact the communities around OCNGS as they would experience the impact of the loss of jobs at OCNGS. The communities around the new site would have to absorb the impacts of a temporary workforce (approximately 400 workers at the peak of construction) and a permanent workforce of approximately 170 workers. In the GEIS, the NRC staff stated that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work. Alternate sites would need to be analyzed on a case-by-case basis, and socioeconomic impacts could range from SMALL to LARGE.

- **Transportation**

Approximately 400 construction workers would be commuting to the OCNGS site over the 5-year construction period for a coal-fired plant. The addition of these commuters to the 470 OCNGS workers also commuting to the site during this period could affect traffic loads on nearby existing highways. Transportation-related impacts during this period of overlap at the OCNGS site are expected to be MODERATE. Impacts during operation of a coal-fired plant at the OCNGS site would be SMALL, because the new plant workforce would be reduced to 170 workers and OCNGS would have ceased operation.

Transportation-related impacts associated with a coal-fired plant at an alternate site would be dependent on the site location. The impacts on transportation associated with 400 commuting construction workers would likely be MODERATE. Transportation impacts related to the commuting of an estimated 170 workers during operations would likely be SMALL.

At the OCNGS site or at an alternate site, coal and lime would probably be delivered by rail. At the OCNGS site, the delivery of coal and lime over a distance of 15 mi is considered a MODERATE to LARGE impact. At an alternate site, impacts associated with rail transportation would depend on the site location and distance to the existing rail line. Impacts associated with rail transportation at an alternate site could range from SMALL to LARGE.

- **Aesthetics**

The coal-fired plant could be as much as 200 ft tall with cooling towers, stack, and coal piles visible in daylight hours. The exhaust stack could be as much as 650 ft high. The plant and associated stack would also be visible at night because of outside lighting. Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided that the lighting meets Federal Aviation Administration requirements (FAA 2000), and appropriate use of shielding. There could be a significant impact if construction of a new transmission line and/or rail spur is needed. Overall, the addition of a coal-fired plant and the associated stacks at the OCNGS site is expected to result in a MODERATE impact. A coal-fired plant at an alternate site would likely have a MODERATE to LARGE aesthetic impact, depending on the site location chosen.

A coal-fired plant would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations, such as cooling towers. Intermittent sources include the equipment related to coal handling, solid waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees. These impacts are considered to be MODERATE.

Noise impacts associated with rail delivery of coal and lime to a plant at the OCNGS site or at an alternate site would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the many residents likely to be within hearing distance of the rail route, the impact of noise on residents in the vicinity of the facility and the rail line are considered MODERATE.

The aesthetic impact associated with the construction and operation of a new transmission line and rail spur at an alternate site could be LARGE, depending on the location of the site chosen. Overall, the NRC staff concludes that the aesthetic impact associated with locating a coal-fired plant at the OCNGS site would be MODERATE and, at an alternate site, MODERATE to LARGE.

- **Historic and Archaeological Resources**

Before construction or any ground disturbance at the OCNGS site or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts at the OCNGS site or at an alternate site could range from SMALL to MODERATE, depending on what resources are present, and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of OCNGS would result in a decrease in employment of approximately 470 operating employees, possibly offset by general growth in the area. Following construction, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, the impact is expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the area could mitigate any adverse effects.

The environmental justice impact at an alternate site would depend on the site chosen and the nearby population distribution, and could range from SMALL to MODERATE.

8.3.1.2 Coal-Fired Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a coal-fired plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a coal-fired plant using the closed-cycle system. However, there are minor differences in impacts between the closed-cycle and once-through cooling systems. Table 8-4 summarizes these differences. The design and operation of the intake would need to comply with Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

Table 8-4. Summary of Environmental Impacts of Coal-Fired Plant Generation Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on ecological conditions in areas to be developed. Possible impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts; thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change

Table 8-4. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and archaeological resources	No change
Environmental justice	No change

8.3.2 Natural-Gas-Fired Plant Generation

The environmental impacts of the natural-gas-fired plant alternative are examined in this section for both the OCNGS site and an alternate site. The NRC staff assumed that the plant would use a closed-cycle cooling system (Section 8.3.2.1). In Section 8.3.2.2, the NRC staff also evaluated the impacts of once-through cooling.

The existing switchyard, offices, and transmission line would be used for the gas-fired alternative at the OCNGS site. For purposes of analysis, AmerGen estimates that approximately 2 mi of buried gas supply pipeline would need to be constructed to connect to the existing pipeline at the Forked River gas plant (AmerGen 2005).

If a new natural-gas-fired plant were built at an alternate site in New Jersey to replace OCNGS, construction of a new natural gas supply pipeline and a new transmission line could be needed. In the GEIS, the NRC staff estimated disturbance of up to 2500 ac for construction of a 60-mi transmission line to an alternate site (NRC 1996).

The NRC staff assumed that a replacement natural-gas-fired plant would use combined-cycle technology (AmerGen 2005). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

AmerGen assumed two standard-sized 300-MW(e) units with a total capacity of 600 MW(e), as the gas-fired plant alternative at OCNGS (AmerGen 2005). This capacity is approximately equivalent to the OCNGS total net capacity of 640 MW(e). AmerGen estimates that the plant would consume approximately 38.4 billion ft^3 of gas annually (AmerGen 2005).

Unless otherwise indicated, the assumptions and numerical values used are from the AmerGen ER (AmerGen 2005). The NRC staff reviewed this information and compared it with environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating a natural-gas-fired plant for 40 years is considered (as a reasonable projection of the operating life of a natural-gas-fired plant).

8.3.2.1 Natural-Gas-Fired Plant with a Closed-Cycle Cooling System

The overall impacts of a natural-gas-fired plant with a closed-cycle cooling system are discussed in the following sections and summarized in Table 8-5. The extent of impacts at an alternate site would depend on the characteristics of the selected location of the plant site.

- **Land Use**

  For siting a natural-gas-fired plant at OCNGS, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the NRC staff assumed that a natural-gas-fired plant would use the existing switchyard, offices, and transmission line. Much of the land that would be used has been previously disturbed. At OCNGS, the staff assumed that approximately 40 ac would be needed for the plant and associated infrastructure. (However, additional land would also be needed for construction of cooling towers for a closed-cycle cooling system.) There would be an additional impact of up to approximately 12 ac for construction of a gas pipeline. Approximately 40 ac of already developed land at the OCNGS site is available (AmerGen 2005).

  For construction at an alternate site, the NRC staff assumed in the GEIS that 110 ac would be needed for a 1000-MW(e) plant and associated infrastructure (NRC 1996). This estimate would be scaled down for the 600-MW(e) capacity of the gas-fired plant alternative considered here (i.e., 66 ac). The additional amount of land impacted by the construction of a new transmission line and a gas pipeline is dependent on the site location chosen. The NRC staff assumed in the GEIS that approximately 2500 ac would be impacted for construction of a 60-mi transmission line (NRC 1996).

  Regardless of where a gas-fired plant is built, additional land (approximately 3600 ac) would be required for natural gas wells and collection stations (NRC 1996). Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for OCNGS. In the GEIS (NRC 1996), the NRC staff estimated that approximately 1000 ac would be affected by the mining and processing of uranium during the operating life of a nuclear power plant.

  Overall, the NRC staff concludes that land-use impact for a gas-fired plant at the OCNGS site would be SMALL to MODERATE given the availability of previously developed and disturbed land that could be used for the plant site, the use of existing transmission systems, and the proximity of an existing gas pipeline. Impacts on land use at an alternate site could be greater, depending on the site chosen and the land requirements for a new transmission line and new gas pipeline, and are characterized as MODERATE to LARGE.

Table 8-5. Summary of Environmental Impacts of a Natural-Gas-Fired Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site Impact	OCNGS Site Comments	Alternate Site Impact	Alternate Site Comments
Land use	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses approximately 40 ac for plant site. Additional impact of up to approximately 12 ac for construction of 2-mi of underground gas pipeline. Additional land needed for cooling towers.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses approximately 66 ac for power block, cooling towers, offices, roads, and parking areas. Additional land would be needed for a new transmission line (amount dependent on site chosen) and for construction and/or upgrade of a gas pipeline.
Ecology	SMALL to MODERATE	Impact would depend on the characteristics of the land to be developed. Uses developed areas at current OCNGS site, reducing impacts on ecology. Impacts could occur with construction of a gas pipeline. Impact on terrestrial ecology from cooling-tower drift. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission and pipeline routes. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in any streams crossed during pipeline construction.	SMALL to MODERATE	Impact would depend on volume of water withdrawn and discharged and characteristics of surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water use.	SMALL to MODERATE	Impact would depend on the location of the site, the volume of water withdrawn and discharged, and characteristics of the aquifer.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality during operations would be MODERATE with the following emissions expected: Sulfur oxides • 42 tons/yr Nitrogen oxides • 135 tons/yr Carbon monoxide • 28 tons/yr PM_{10} particulates • 24 tons/yr Some hazardous air pollutants.	MODERATE	Same emissions as a natural-gas-fired plant at the OCNGS site, although pollution-control standards may vary depending on location. Impacts during construction would be SMALL. Impacts during operation would be MODERATE.
Waste	SMALL	Waste would be generated and removed during construction. Minimal waste from fuel consumption during operation.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Human health risks associated with gas-fired plants may result from NO_x emissions, which are regulated. Impacts are expected to be SMALL.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 360 additional workers during the peak of the 3-year construction period, followed by a reduction of the current OCNGS workforce from 470 to 24. Ocean County would experience a reduced demand for goods and services as well as a loss in its tax base and employment, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.	MODERATE	Construction impact would depend on location, but could be MODERATE if the location is in a rural area. Up to 360 additional workers during the peak of the 3-year construction period. Ocean County would experience a loss in its tax base and employment if the plant is built outside of the county, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.
Transportation	MODERATE	Transportation impact associated with construction workers would be MODERATE, as 470 OCNGS workers and 360 construction workers would be commuting to the site. Impact during operation would be SMALL as the number of commuters would be reduced to 24.	MODERATE	Transportation impact associated with 360 construction workers would be MODERATE. Impact during operation would be SMALL as the number of commuters would be reduced to 24.
Aesthetics	SMALL to MODERATE	SMALL to MODERATE aesthetic impact due to visibility of plant units, exhaust stacks, cooling towers and plumes, and gas compressors. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would result in SMALL to MODERATE impact.	SMALL to MODERATE	Impact would depend on the characteristics of the site, but would be similar to those for a natural-gas-fired plant at the OCNGS site with additional impact from the new transmission line and gas pipeline. The impact could range from SMALL to MODERATE.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of new plant construction.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new plant construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; the loss of 446 operating jobs at OCNGS could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at site.

- **Ecology**

At the OCNGS site, there would be ecological impacts related to possible habitat loss and to cooling-tower drift associated with siting of a gas-fired plant. There also would be ecological impacts associated with bringing a new underground gas pipeline to the OCNGS site. Impacts due to habitat loss could be reduced through the use of previously impacted land. Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new gas pipeline and/or transmission line. Construction of the transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have ecological impacts. Ecological impacts on the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. The use of cooling makeup water from a nearby surface-water body could cause entrainment and impingement of fish and other aquatic organisms, and result in adverse impacts on aquatic resources. However, rates of entrainment and impingement would be greatly reduced from current levels associated with operation of the existing once-through cooling system.

Overall, the NRC staff concludes that ecological impact of a gas-fired plant at the OCNGS site would be SMALL to MODERATE given the availability of previously developed and disturbed land that could be used for the plant site, the use of the existing transmission system, and the proximity of an existing gas pipeline. Impact at an alternate site could be greater, depending on the site chosen and the land requirements for a new transmission line and new gas pipeline, and are characterized as MODERATE to LARGE.

- **Water Use and Quality**

Surface Water. Each of the natural-gas-fired units would include a heat-recovery boiler, using a portion of the waste heat from the combustion turbines to generate additional electricity. The net result would be an overall reduction in the amount of waste heat rejected from the plant, with an associated reduction in the amount of cooling water required by the plant. Thus, the cooling-water requirements for the natural-gas-fired combined-cycle units would be much less than those for conventional steam-electric generators, including the existing nuclear unit. Plant discharge would consist mostly of cooling-tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids, relative to the receiving body of water, and intermittent low concentrations of biocides (e.g., chlorine). In addition to the cooling-tower blowdown, treated process waste streams and sanitary wastewater might also be discharged. All discharges would be regulated by the NJDEP. There would be consumptive use of water due to evaporation from the cooling towers. Overall, the surface-water impacts of operation under the natural-gas-fired plant alternative at the OCNGS site are considered SMALL.

A natural-gas-fired plant at an alternate site is assumed to use surface water for cooling makeup water and discharge. Intake and discharge would involve relatively small quantities of water compared with the coal-fired plant alternative. The impact on surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Discharges would be the same as those described above for a gas-fired plant at the OCNGS site. Intake from and discharge to any surface body of water would be regulated by the NJDEP. The impact would be SMALL to MODERATE.

Water-quality impacts from sedimentation during construction were characterized in the GEIS as SMALL (NRC 1996). The NRC staff also noted in the GEIS that operational water-quality impacts would be similar to, or less than, those from other generating technologies.

Groundwater. Any groundwater withdrawal would require a permit from the local permitting authority. OCNGS currently uses groundwater for potable water, and this practice would likely continue under the gas-fired plant alternative. Impacts on groundwater use and quality would be considered SMALL. Impacts on groundwater at an alternate site would depend on the volume of water needed and characteristics of the groundwater source. The

NRC staff concludes that impacts at an alternate site would be SMALL to MODERATE, depending on site-specific conditions.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired plant alternative would release similar types of emissions, but in lesser quantities than the coal-fired plant alternative.

A new gas-fired plant located in New Jersey would likely need a PSD permit and an operating permit under the CAA. A new combined-cycle natural gas power plant would also be subject to the new-source performance standards for such units at 40 CFR Part 60, Subparts D(a) and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

In 1998, the EPA issued a rule requiring 20 eastern states, including New Jersey, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard (40 CFR 50.9) for ozone. The total amount of NO_x that can be emitted by each of the 20 states in the 2007 ozone season (May 1 to September 30) is presented in 40 CFR 51.121(e). For New Jersey, the amount is 330,836 tons/yr (EPA 2001).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the CAA. Portions of New Jersey have been classified as attainment or unclassified for criteria pollutants (40 CFR 81.331). In the posted amendment to that classification dated April 30, 2004, there are several instances of nonattainment for ozone, including Ocean County (EPA 2004b).

Section 169A of the CAA establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (64 FR 35714; July 1,1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a natural-gas-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Brigantine National Wildlife Refuge, located about 20 mi south of OCNGS, is a Class I area where visibility is an important value (40 CFR 81.414). Air quality in this area could be affected by a natural-gas-fired plant at the OCNGS site and at an alternate site, if the site chosen were located within 62 mi of the wildlife refuge.

AmerGen projects the following emissions for the natural-gas-fired plant alternative (AmerGen 2005):

- Sulfur oxides – 42 tons/yr
- Nitrogen oxides – 135 tons/yr
- Carbon monoxide – 28 tons/yr
- PM_{10} particulates – 24 tons/yr

A natural-gas-fired plant would also have unregulated CO_2 emissions that could contribute to global warming.

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA found that natural-gas-fired power plants emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal- and oil-fired plants, the EPA did not determine that emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the CAA.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. Air emissions would likely be the same at OCNGS or at an alternate site. The overall air quality impact for a new natural-gas-fired plant sited at OCNGS or at an alternate site is considered MODERATE.

- **Waste**

There would be spent SCR catalyst from NO_x emissions control and small amounts of solid waste products (i.e., ash) from burning natural gas fuel. In the GEIS, the NRC staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Natural gas combustion results in very few by-products because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities.

Overall, the waste impacts associated with the natural-gas-fired plant alternative would be SMALL for a plant sited at OCNGS or at an alternate site.

- **Human Health**

In Table 8-2 of the GEIS, the NRC staff identified cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x

emissions that contribute to ozone formation, which in turn contributes to health risks. Nitrogen oxide emissions from any gas-fired plant would be regulated. For a plant sited in New Jersey, NO_x emissions would be regulated by the NJDEP. Overall, the impact on human health of the natural-gas-fired plant alternative sited at OCNGS or at an alternate site is considered SMALL.

- **Socioeconomics**

Construction of a natural-gas-fired plant would take approximately 3 years. Peak employment would be approximately 360 workers (AmerGen 2005). The NRC staff assumed that construction would take place while OCNGS continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the OCNGS site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Ocean County or from other nearby counties. After construction, the communities would be impacted by the loss of jobs. The current OCNGS workforce (approximately 470 workers) would decline through a decommissioning period to a minimal maintenance size. The gas-fired plant would introduce a replacement tax base at OCNGS or at an alternate site and approximately 24 new permanent jobs. This would represent a net loss of 446 jobs at the OCNGS site.

In the GEIS (NRC 1996), the NRC staff concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared with the coal-fired and nuclear plant alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts. The loss of 446 permanent jobs (up to 470 jobs if an alternate site is not located in Ocean County) may be partially tempered by the projected economic growth of the area. For these reasons, socioeconomic impacts associated with construction and operation of a natural-gas-fired power plant would be MODERATE and SMALL, respectively, for siting at OCNGS or at an alternate site.

- **Transportation**

Transportation impacts associated with construction and operating personnel commuting to a natural-gas-fired plant would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as MODERATE for construction and SMALL for operation at OCNGS or at an alternate site.

- **Aesthetics**

For a natural-gas-fired plant, the turbine buildings (approximately 100 ft tall) and exhaust stacks (approximately 125 ft tall), and cooling towers and plumes would be visible during daylight hours from offsite. The gas pipeline compressors also would be visible. Noise and light from the plant would be detectable offsite. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would result in SMALL to MODERATE impact. Overall, the aesthetic impacts associated with construction and operation of a natural-gas-fired plant at the OCNGS site are categorized as SMALL to MODERATE.

At an alternate site, the buildings, cooling towers, cooling-tower plumes, and the associated transmission line and gas pipeline compressors would be visible offsite. There would also be a visual impact from a new transmission line. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Noise impacts would be similar to those described for the OCNGS site. Overall, the aesthetic impacts associated with an alternate site are categorized as SMALL to MODERATE and would depend on the characteristics of the area to be developed. Depending on the site chosen, the greatest contributor to aesthetic impact would be the new transmission line.

- **Historic and Archaeological Resources**

Before construction or any ground disturbance at OCNGS or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts ranges from SMALL to MODERATE, depending on what resources are present and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a new natural-gas-fired plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of OCNGS would result in a decrease in employment of approximately 470 operating employees, partially offset by the 24 workers required for operation of the new plant, and possibly by general growth in the area. Following construction, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, environmental justice impacts are expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the area could mitigate any adverse effects.

Environmental justice impact at an alternate site would depend upon the site chosen and the nearby population distribution; therefore, impacts could range from SMALL to MODERATE.

8.3.2.2 Natural-Gas-Fired Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a natural-gas-fired plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a natural-gas-fired plant using the closed-cycle system. However, there are minor differences between the closed-cycle and once-through cooling systems. Table 8-6 summarizes these differences. The design and operation of the intake would need to comply with Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

8.3.3 Nuclear Power Plant Generation

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1300-MW(e) U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300-MW(e) System 80+ Design (10 CFR Part 52, Appendix B), the 600-MW(e) AP600 Design (10 CFR Part 52, Appendix C), and the advanced 1117- to 1154-MW(e) AP1000 design (10 CFR Part 52, Appendix D). All these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. In addition, System Energy Resources, Inc., Exelon Generation Company, LLC, and Dominion Nuclear North Anna, LLC, have recently submitted applications for early site permits for new advanced nuclear power plants under the procedures in 10 CFR Part 52, Subpart A (SERI 2003; Exelon 2003; Dominion 2003). Consequently, construction of a new nuclear power plant at either the OCNGS site or at an alternate site is considered in this section. The NRC staff assumed that the new nuclear plant would have a 40-year lifetime. Consideration of a new nuclear generating plant to replace OCNGS was not included in the AmerGen ER (AmerGen 2005).

Table 8-6. Summary of Environmental Impacts of Natural-Gas-Fired Plant Generation Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on the ecological conditions in areas to be developed. Potential impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts, thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and archaeological resources	No change
Environmental justice	No change

The NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at OCNGS or at an alternate site. In the GEIS, the NRC estimated that for a 1000-MW(e) reactor, 500 to 1000 ac would be required for construction (NRC 1996). The impacts shown in Table S-3 were adjusted to reflect the replacement of 640 MW(e) generated by OCNGS. The environmental impacts associated with transporting fuel and waste to and from a light-water-cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52.

The summary of the NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a new nuclear power plant. Additional environmental impact information for a new nuclear power plant using closed-cycle cooling is presented in Section 8.3.3.1, and using once-through cooling is presented in Section 8.3.3.2.

8.3.3.1 New Nuclear Plant with a Closed-Cycle Cooling System

The overall impacts of a new nuclear plant are discussed in the following sections and are summarized in Table 8-7. The extent of impacts at an alternate site would depend on the location of the site that is selected.

In addition to the impacts discussed below, impacts would occur offsite as a result of uranium mining. Impacts of mining would include an increase in fugitive dust emissions, surface-water runoff, erosion, sedimentation, changes in water quality, disturbance of vegetation and wildlife, disturbance of historic and archaeological resources, changes in land use, and impacts on employment.

The magnitude of these offsite impacts would be largely proportional to the amount of land affected by mining. However, there would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel at OCNGS.

- **Land Use**

  The existing facilities and infrastructure at the OCNGS site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the NRC staff assumed that a new nuclear power plant would use the existing switchyard, offices, and transmission line rights-of-way. Much of the land that would be used has been previously disturbed. A new nuclear power plant at the OCNGS site would alter approximately 320 to 640 ac of land (NRC 1996).

  The impact of a new nuclear plant on land use at the existing OCNGS site is best characterized as MODERATE to LARGE, because the existing site may not be large enough to accept the additional land requirements for construction. Additional land may have to be obtained outside of the existing boundaries, or OCNGS might have to be dismantled before new construction began. The impact would be greater than under the proposed action.

  Land-use impacts at an alternate site would be similar to siting at OCNGS except for the land needed for a transmission line to connect to the grid. The amount of land needed for the transmission line would depend upon the location of the alternate site. In addition, it may be necessary to construct a rail spur to an alternate site to bring in equipment during construction. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate site would result in MODERATE to LARGE land-use impacts.

- **Ecology**

  Locating a new nuclear power plant at the OCNGS site would alter ecological resources because of the need to convert about 320 to 640 ac of land to industrial use. Some of this land, however, would have been previously disturbed.

  Siting a new nuclear plant at OCNGS would have a MODERATE to LARGE ecological impact that would be greater than under the proposed action. Development of previously undisturbed lands could result in impacts on threatened or endangered species, wildlife habitat destruction, habitat fragmentation, reduced productivity, and local reductions in biological diversity. The magnitude of the impact would depend on the characteristics of the land to be developed. Cooling-tower drift could result in impacts on terrestrial ecology, especially nearby vegetation. The use of cooling towers to replace once-through cooling would reduce thermal discharge and the entrainment and impingement of aquatic organisms.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would affect ecological resources. Impacts could include impacts on threatened and endangered species, wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could have adverse aquatic resource impacts. Impacts on terrestrial ecology could result from cooling-tower drift. Construction and maintenance of a transmission line, if needed, would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE and would depend on the ecological conditions at the site and the amount of land to be developed.

- **Water Use and Quality**

Surface Water. A new nuclear plant at the OCNGS site would require the construction of cooling towers for a closed-cycle cooling system. The use of a closed-cycle cooling system would reduce impacts on surface water relative to the existing once-through system at OCNGS. Plant discharge would consist mostly of cooling-tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids, relative to the receiving body of water, and intermittent low concentrations of biocides (e.g., chlorine). In addition to the cooling-tower blowdown, treated process waste streams and sanitary wastewater might also be discharged. All discharges would be regulated by the State of New Jersey through a NJPDES permit. Surface-water impacts are expected to be SMALL.

At an alternate site, the impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the NJDEP. The impacts would be SMALL to MODERATE, and their magnitude would depend on the characteristics of the surface-water body used as the source of cooling water.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	MODERATE to LARGE	Impact would depend on the degree to which previously disturbed lands were utilized. Requires approximately 320 to 640 ac for the plant. Additional offsite land use impacts from uranium mining.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Impact would be generally the same as a new nuclear plant at the OCNGS site plus additional land for a transmission line.
Ecology	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed. Uses developed and undeveloped areas at current OCNGS site and possibly additional undeveloped land adjacent to the site. Impact on terrestrial ecology from cooling-tower drift. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission line route. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for reactor makeup water and potable water use.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the aquifer.

Table 8-7. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be MODERATE. Emissions from diesel generators and possibly other sources during operation would be similar to current OCNGS operation, and their impact on air quality would be SMALL.	MODERATE	Same impacts as a new nuclear plant at the OCNGS site. Impact during construction would be SMALL. Impact during operation would be MODERATE.
Waste	SMALL	Waste would be generated and removed during construction. Waste impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impact as a new nuclear plant at the OCNGS site.
Human health	SMALL	Human health impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impact as a new nuclear plant at the OCNGS site.
Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 1600 workers during peak period of the 6-year construction period. Operating workforce assumed to be similar to OCNGS; tax base preserved. Impacts during operation would be SMALL.	MODERATE to LARGE	Construction impact would depend on location, but could be LARGE at a rural location. Ocean County would experience a loss in its tax base and employment if the chosen site is located outside of the county, but possibly offset by economic growth in the area.
Transportation	MODERATE to LARGE	Transportation impact associated with 1600 construction workers in addition to 470 OCNGS workers would be MODERATE to LARGE. Transportation impact of commuting personnel would be SMALL.	MODERATE to LARGE	Impact would depend on the location of the site. Transportation impacts of 1600 construction workers could be MODERATE to LARGE. Transportation impacts of 470 commuting personnel could be SMALL to MODERATE.

Table 8-7. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Aesthetics	SMALL to MODERATE	Aesthetic impact due to the addition of cooling towers and other structures would be SMALL to MODERATE. Intermittent noise from construction and commuter traffic and continuous noise from cooling towers and mechanical equipment could result in impacts ranging from SMALL to MODERATE.	SMALL to MODERATE	Impact would depend on the characteristics of the site but would be similar to those for a new nuclear plant at the OCNGS site. Additional visual impacts would occur from the new transmission line that would be needed.
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.	SMALL to MODERATE	Impact would depend on the characteristics of the alternative site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. SMALL impact on housing could occur during construction. Employment impacts would be similar to the current operation of OCNGS and are expected to be SMALL.	SMALL to LARGE	Impacts would vary, depending on population distribution and makeup at the site.

Groundwater. The NRC staff assumed that a new nuclear power plant located at OCNGS would continue the current practice for OCNGS of using groundwater for reactor makeup water and potable water (see Section 2.2.2). Use of groundwater for a nuclear power plant sited at an alternate site would require a permit from the local permitting authority.

Overall, the impacts on groundwater use and quality from a closed-cycle new nuclear plant at the OCNGS site are considered SMALL. Impacts from a similar plant at an alternate site are considered to be SMALL to MODERATE, depending on the volume of groundwater used and characteristics of the aquifer.

- **Air Quality**

Construction of a new nuclear plant sited at OCNGS or at an alternate site would result in fugitive dust emissions during the 6-year construction period. Exhaust emissions would also be produced by vehicles and motorized equipment used during the construction process. Air quality impacts from construction could be MODERATE. An operating nuclear plant would have minor air emissions associated with diesel generators and other minor intermittent sources and would be similar to the current impacts associated with operation of OCNGS (i.e., SMALL).

- **Waste**

The waste impacts associated with operation of a nuclear power plant are presented in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related waste would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

Siting a new nuclear power plant at a site other than OCNGS would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

Siting the replacement nuclear power plant at a site other than OCNGS would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

For the construction of a new nuclear power plant, the NRC staff assumed a construction period of 6 years and a peak workforce of 1600 (NRC 1996). Additional land may have to be acquired to construct a new nuclear plant at the OCNGS site, or OCNGS might have to be decommissioned and dismantled before construction began. During construction, the communities surrounding the OCNGS site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Ocean County or from other nearby counties.

A new nuclear plant is assumed to have an operating workforce comparable to the 470 workers currently working at OCNGS. The new nuclear plant would provide a new tax base to offset the loss of tax base associated with decommissioning of OCNGS. For these reasons, the NRC staff concludes that the socioeconomic impacts for a replacement nuclear plant constructed at OCNGS would be MODERATE during construction and SMALL during operation.

If a new nuclear power plant were constructed at an alternate site, the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 1600 workers at the peak of construction) and a permanent workforce of approximately 470 workers. In the GEIS (NRC 1996), the NRC staff indicated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. Alternate sites would need to be analyzed on a case-by-case basis, and impacts could range from MODERATE to LARGE, depending on the socioeconomic characteristics of the area around the site.

- **Transportation**

During the 6-year construction period, up to 1600 construction workers and 470 OCNGS workers would be commuting to the OCNGS site. The addition of the construction workers could place significant traffic loads on existing highways. Such impact would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of OCNGS and are considered SMALL.

Transportation-related impacts associated with commuting construction workers at an alternate site are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE, and would depend on the characteristics of the transportation system and population in the vicinity of the site.

- **Aesthetics**

The containment buildings for a new nuclear power plant sited at OCNGS and other associated buildings would likely be visible in daylight hours over many miles. Mechanical-draft towers could be up to 100 ft high and would also have an associated noise impact and condensate plumes. The replacement nuclear plant would also likely be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. The aesthetic impact due to the addition of cooling towers and other structures would be SMALL to MODERATE.

Intermittent noise impacts from construction and commuter traffic are likely. Continuous noise from a new nuclear plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the listener. Noise impacts from a new nuclear plant would be similar to those from the existing OCNGS unit. Mitigation measures, such as reduced or no use of outside loudspeakers, could be employed to reduce noise impacts to levels that would range from SMALL to MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings, cooling towers, and the plume associated with the cooling towers. There could also be a significant aesthetic impact associated with construction of a new transmission line. The length of the transmission line would depend upon the location of the plant. Noise and light from the plant would be detectable offsite. The impact of noise and light would be less if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating a new nuclear plant at an alternate site can be categorized as SMALL to MODERATE. Depending on the location chosen, the greatest contributor to this categorization could be the aesthetic impact of the new transmission line.

- **Historic and Archaeological Resources**

Before construction or any ground disturbance at OCNGS or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts ranges from SMALL to MODERATE, whether at the OCNGS site or an alternate site, depending on what resources are present and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a new nuclear plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. Overall, impacts are expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the Ocean County area could mitigate any adverse effects.

The environmental justice impact at an alternate site would depend upon the site chosen and the nearby population distribution, and could range from SMALL to LARGE.

8.3.3.2 New Nuclear Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a new nuclear power plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a nuclear power plant using a closed-cycle system. However, there are minor differences between the closed-cycle and once-through cooling systems. Table 8-8 summarizes these differences. The design and operation of the intake would need to comply with Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

Table 8-8. Summary of Environmental Impacts of a New Nuclear Power Plant Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on the ecological conditions in areas to be developed. Possible impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts, thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers are not used.
Historic and archaeological resources	No change
Environmental justice	No change

8.3.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the OCNGS OL. It is unlikely, however, that sufficient baseload, firm power supply would be available to replace OCNGS capacity.

Imported power from Canada or Mexico is unlikely to be available for replacement of OCNGS capacity. In Canada, 60 percent of the country's electrical generation capacity is derived from renewable energy sources, principally hydropower (EIA 2004). Canada plans to expand hydroelectric capacity, including large-scale projects (EIA 2004). Canada's nuclear generation is projected to increase from 10,000 MW in 2001 to 15,200 MW in 2020 before reaching a forecasted decline to 12,400 MW in 2025 (EIA 2004). The EIA projected that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 38.4 billion kWh in 2001 to 47.2 billion kWh in 2010 and then gradually decrease to 15.2 billion kWh in 2025 (EIA 2004). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace OCNGS capacity.

If power to replace OCNGS capacity were to be purchased from sources within the United States or a foreign country, the power-generation technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the OCNGS OL. Thus, the environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country.

8.3.5 Other Alternatives

Other power-generation technologies considered by the NRC are discussed in the following paragraphs.

8.3.5.1 Oil-Fired Plant Generation

The EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States between 2005 and 2025 because of higher fuel costs and lower efficiencies (EIA 2004). AmerGen has several oil-fired units in the Pennsylvania, New Jersey, and Maryland area. These units produce less than 2 percent of AmerGen's total power (AmerGen 2005). Oil-fired generation is more expensive than nuclear or coal-fired generation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. For these reasons, oil-fired generation is not considered an economically feasible alternative to OCNGS license renewal.

Construction and operation of an oil-fired plant would have environmental impacts. For example, in Section 8.3.11 of the GEIS, the NRC staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land for the facility and additional land for an oil pipeline (NRC 1996). In addition, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those of a coal-fired plant.

8.3.5.2 Wind Power

Wind power, by itself, is not a suitable alternative to replace the large baseload electrical generating capacity of OCNGS. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind plants are relatively low (on the order of 30 percent) (NRC 1996). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive for wind power to serve as a large baseload generator.

The New Jersey coast, including Ocean County, has marginal-to-fair wind power potential. The annual wind power estimates for the New Jersey coast indicates a rating of Class 2 and some Class 3, increasing to Classes 4 and 5 offshore (DOE 2006a). However, the wind power class attenuates rapidly to Class 1 (poor) inland from the coastline. Areas designated Class 3 or greater are suitable for most wind energy applications (DOE 2004a). Land-use conflicts, such as urban development, farmland, and environmentally sensitive areas, also minimize the amount of land suitable for wind energy applications (PNL 1986).

DOE’s National Renewable Energy Laboratory (NREL) estimates that the footprint of a 1.5 MW wind turbine is between 0.25 and 0.5 ac. In addition, a spacing interval of 5 to 10 turbine rotor diameters between wind turbines is typically maintained to prevent interferences between turbines (NREL 2006). Five turbine rotor diameters would be suitable for optimal wind conditions, increasing to 10 depending on the amount of wind turbulence and other potential topographic disturbances. Land disturbance during construction to install the turbine is estimated to be between 1 to 3 ac per turbine related to grading the site for installation, laydown areas for equipment and materials, and staging areas for construction equipment used to hoist the turbines and their towers into place. The area surrounding the turbine is then reclaimed after construction is completed. These estimates do not include land used for substations, control buildings, access roads, and other related facilities. Assuming the largest available land-based turbine is used (currently, 1.5 MW), 427 turbines are estimated to be needed in land areas with a wind class of Class 3 or greater to produce 640 MW(e), using the NREL’s Wind Farm Area Calculator (NREL 2006). Assuming a rotor diameter of roughly 200 ft for a 1.5-MW turbine, the total acreage for a wind farm with 427 turbines in optimal wind conditions could require more than 2,000 ac; 213.5 ac would be dedicated to the turbine footprint (assuming approximately 0.5 ac per turbine base), and the remaining land between turbines could be available for other uses, such as grazing or agricultural land. These numbers do not take into account the low annual capacity factor of approximately 30 percent that is associated with wind energy.

The current OCNGS site is too small to support a baseload level of wind generation capacity. At an alternate site, this large amount of land required along the coastline could result in a LARGE environmental impact. Larger turbines could be used for offshore wind development where the wind class is greater, but even a 4-MW turbine (the largest currently available turbine for offshore use is 3.6 MW) would require about 160 turbines, with greater spacing required between turbines because of the greater rotor lengths, to produce 640 MW(e). Although impacts would depend on the site chosen, common issues of concern include visual impacts, noise, potential interferences with aircraft operations, and bird and bat collisions. Consequently, the NRC staff concludes that locating a baseload, utility-scale wind energy facility on the OCNGS site or at an alternate site would not be economically feasible given the current state of wind generation technology.

8.3.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. In the GEIS, the NRC staff noted that by its nature, solar power is intermittent. Therefore, solar power by itself is not suitable for baseload capacity and is not a feasible alternative to license renewal of OCNGS. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent. Solar power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive to permit solar power to serve as a large baseload generator.

Therefore, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications because of high costs per kilowatt of capacity (NRC 1996).

Natural resources (e.g., wildlife habitat, land use, and aesthetics) can incur substantial impacts from construction of solar-generating facilities. As stated in the GEIS, land requirements are high – 35,000 ac per 1000 MW(e) for photovoltaic and approximately 14,000 ac per 1000 MW(e) for solar thermal systems. Neither type of solar electric system would fit at the OCNGS site, and both would have LARGE environmental impacts at an alternate site.

New Jersey receives between approximately 3.0 to 4.5 kWh of solar radiation per square meter per day, compared with 6 to 8 kWh of solar radiation per square meter per day in areas of the southwestern United States, such as Arizona and California, which are most promising for solar technologies (DOE 2006b). Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible baseload alternative to renewal of the OCNGS OL. Some solar power may be substituted for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace OCNGS would likely result in LARGE environmental impacts.

8.3.5.4 Hydropower

There are no remaining sites in the New Jersey market region that would be environmentally suitable for a hydroelectric facility to replace the generating capacity of OCNGS (INEEL 1998). In Section 8.3.4 of the GEIS, the NRC staff points out that hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

The NRC staff estimated in the GEIS that land requirements for hydroelectric power are approximately 1 million ac per 1000 MW(e). Replacement of OCNGS generating capacity would require flooding less than this amount of land. Because of the lack of suitable sites in New Jersey and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace OCNGS, the NRC staff concludes that hydropower is not a feasible alternative to OCNGS OL renewal on its own. Any attempts to site hydroelectric facilities large enough to replace OCNGS would result in LARGE environmental impacts.

8.3.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated in Figure 8.4 in the GEIS, geothermal electric-generating plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. There is no feasible location in New Jersey for geothermal capacity to serve as an alternative to OCNGS (DOE 2006b). The NRC staff concludes that geothermal energy is not a feasible alternative to renewal of the OCNGS OL.

8.3.5.6 Wood Waste

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries that consume wood and wood waste for energy; these industries benefit from the use of waste materials that could otherwise represent a disposal problem.

DOE estimates that New Jersey has some resources for wood fuels consisting of urban, mill, and forest residues; approximately 800,181 dry tons/yr are available in New Jersey (Walsh et al. 2000). The National Renewable Energy Laboratory (NREL) has estimated that 1100 kW(h) of electricity can be produced by 1 dry ton of wood residue. Therefore, approximately 0.88 TWh of electricity can be generated from wood residue in New Jersey (NREL 2004).

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

While wood resources are available in New Jersey, wood energy is not considered a reasonable alternative to renewal of the OCNGS OL because of the disadvantages of low heat content, handling difficulties, and high transportation costs.

8.3.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2004c). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (EIA 2001). Mass-burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste “as is,” with little or no sizing, shredding, or separation before combustion.

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (EIA 2001). The EIA projects an increase in electricity generation from municipal solid waste and landfill gas by 7 billion kWh to 29 billion kWh in 2025; however, no new capacity is expected (EIA 2005).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics, particularly with electricity prices declining in real terms. U.S. electricity prices in 2002 dollars are expected to decline by 8 percent between 2002 and 2008 and remain stable until 2011 (EIA 2004). Prices are expected to increase by 0.3 percent per year from 2011 until 2025, following the trend of the generation component of electricity price (EIA 2004).

Municipal solid waste combustion generates an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters or scrubbers (EIA 2001).

Currently, there are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2500 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2004), a much smaller capacity than that needed to replace the 640 MW(e) of OCNGS.

The initial capital costs for municipal solid waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996). Furthermore, estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. In addition, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be MODERATE, but still larger than the environmental effects of license renewal of OCNGS. Therefore, municipal solid waste would not be a feasible alternative to renewal of the OCNGS OL, particularly at the scale required.

8.3.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for power generation, including burning crops, converting crops to a liquid fuel such as ethanol, and converting crops or wood waste to gaseous fuel. In the GEIS, the NRC staff points out that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as OCNGS. For these reasons, such fuels do not offer a feasible alternative to renewal of the OCNGS OL.

8.3.5.9 Fuel Cells

Fuel cells work without combustion and its environmental impacts. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and CO_2. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. These fuel cells are commercially available at a cost of approximately $4000 to $4500/kW of installed capacity

(DOE 2004b). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

It is unlikely that the costs of existing fuel cell systems will drop below $1000/kW; therefore, the DOE has formed the Solid State Energy Conversion Alliance (SECA), with the goal of producing new fuel cell technologies at a cost of $400/kW or lower by 2010 (DOE 2004c). Fuel cells have the potential to become economically competitive if SECA can reach its goal. For comparison, the installed capacity cost for a natural-gas-fired, combined-cycle plant is about $500 to $600/kW (Northwest Power Planning Council 2000). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Consequently, fuel cells are not a feasible alternative to renewal of the OCNGS OL.

8.3.5.10 Delayed Retirement

Existing generating units slated for retirement would likely require major refurbishment to upgrade or replace plant components to meet current environmental regulations, such as those regarding air emissions. For this reason, delayed retirement of other AmerGen generating units would not be a feasible alternative to renewal of the OCNGS OL. AmerGen concluded in its ER (AmerGen 2005) that the environmental impacts of delayed retirement of non-nuclear generating sources would be similar to the impacts from the operation of coal-fired and natural-gas-fired plants. The NRC staff agrees that delayed retirement is not a feasible alternative to renewal of the OCNGS OL.

8.3.5.11 Utility-Sponsored Conservation

Market conditions that initially favored utility-sponsored conservation programs (i.e., DSM), including educational programs, energy efficiency programs, and load management programs, have changed significantly. The viability of new or expanded DSM programs has decreased in recent years because of increased competition in the electric utility industry, mandated energy efficiency standards, and years of customer education programs that have made efficiency the normal practice. New Jersey has a Clean Energy Program and other energy efficiency incentives and programs for use of energy-efficient appliances, incentives (sales tax exemptions) for use of cogeneration power, transportation initiatives, a greenhouse gas initiative, and updated mandatory energy codes for new building construction (Alliance to Save Energy 2006). Although this program has resulted in peak demand reductions, and the environmental impacts of implementing a DSM program would be SMALL, implementation would not be able to realistically replace the 640 MW(e) of net generating capacity of OCNGS. Therefore, the conservation alternative by itself is not considered a reasonable alternative to renewing the OCNGS OL.

8.3.6 Combination of Alternatives

Even though individual alternatives to OCNGS might not be sufficient on their own to replace OCNGS capacity because of the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective. As discussed previously, OCNGS has a combined net electrical capacity of 640 MW(e). For the coal- and natural-gas-fired plant alternatives, the use of standard-sized units as potential replacements for OCNGS were assumed for purposes of the analyses.

There are many possible combinations of alternatives. Table 8-9 presents the environmental impacts of one assumed combination of alternatives consisting of 530 MW(e) of combined-cycle natural-gas-fired plant generation using closed-cycle cooling, a DSM reduction in peak electric demand of 40 MW(e), and 70 MW in purchased power. The NRC staff considered a natural-gas-fired plant over a coal-fired plant because a comparison of the impacts indicates that a coal-fired plant would have greater impacts than a similar-sized gas-fired plant (see Tables 8-3 and 8-5). Also, the footprint of the natural-gas-fired plant is smaller and could be easily accommodated within previously disturbed portions of the OCNGS site. The impacts are based on the assumptions for constructing and operating a natural-gas-fired plant, as discussed in Section 8.2.2, adjusted for the reduced capacity. Energy reduction savings associated with DSM would result in no addition to the environmental impacts listed in Table 8-9 for a natural-gas-fired plant.

Operation of a new natural-gas-fired plant would result in increased emissions (compared with the proposed action) and other environmental impacts. Environmental impacts related to the number of acres of land disturbed and air emissions are scaled based on the reduced amount of electricity produced. However, the number of workers was not likewise scaled. Conservatively, the number of workers for a 600-MW(e) plant, as used in Table 8-5, is also used here for a 530-MW(e) natural-gas-fired-plant. The environmental impacts of power generation associated with power purchased from other generators would still occur, but would be located elsewhere in the region, nation, or another country (Canada) as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-9.

The NRC staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with the proposed action.

Table 8-9. Summary of Environmental Impacts of Combination of Alternatives at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses 32 ac for plant site. Additional impact of up to approximately 12 ac for construction of a 2-mi underground gas pipeline.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses 58 ac for power block, offices, cooling towers, roads, and parking areas. Additional land needed for a new transmission line (amount dependent on site chosen) and for construction and/or upgrade of a gas pipeline.
Ecology	SMALL to MODERATE	Impact would depend on the characteristics of land to be developed. Uses developed areas at current OCNGS site, thereby reducing impacts on ecology. Impacts could occur with construction of a gas pipeline. Impacts on terrestrial ecology from cooling-tower drift are expected. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission and pipeline routes.
Water use and quality – surface water	SMALL	Impact would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.	SMALL to MODERATE	Impact would depend on volume of water withdrawn and discharged and characteristics of surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water.	SMALL to MODERATE	Impact would depend on the location of the site, volume of water withdrawn and discharged, and the characteristics of the aquifer.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality would be MODERATE with the following emissions expected: Sulfur oxides • 37 tons/yr Nitrogen oxides • 119 tons/yr Carbon monoxide • 172 tons/yr PM_{10} particulates • 22 tons/yr Some hazardous air pollutants.	MODERATE	Same emissions as a natural-gas-fired plant at the OCNGS site, although pollution control standards may vary depending on location.
Waste	SMALL	Minimal waste product from fuel consumption. Waste would be generated and removed during construction.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Human health risks associated with natural-gas-fired plants may be attributable to NO_x emissions, which are regulated. Impacts considered SMALL.	SMALL	Same impacts as a natural-gas-fired plant at the OCNGS site.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impact would be SMALL to MODERATE. Up to 360 additional workers during the peak of the 3-year construction period, followed by a reduction in the current OCNGS workforce from 470 to 24. Ocean County would experience reduced demand for goods and services as well as a loss in its tax base and employment, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.	SMALL to MODERATE	Construction impact would depend on location, and likely be SMALL, but could be MODERATE if the location is in a rural area. 360 additional workers during the peak of the 3-year construction period. Ocean County would experience a loss in its tax base and employment if a plant were constructed outside of the county, but this would be potentially offset by projected economic growth in the area.
Transportation	MODERATE	Transportation impact associated with construction workers would be MODERATE as 470 OCNGS workers and up to 360 construction workers would be commuting to the site. Impact during operation would be SMALL as the number of commuters would be reduced to 24.	MODERATE	Transportation impact associated with 360 construction workers and 24 plant workers would be MODERATE and SMALL, respectively.
Aesthetics	SMALL to MODERATE	SMALL to MODERATE aesthetic impact due to visibility of plant units, exhaust stacks, cooling towers, plumes, and gas compressors. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would occur.	SMALL to MODERATE	Impact would depend on the characteristics of the site, but would be similar to those for a natural-gas-fired plant at the OCNGS site, with additional impact from the new transmission line and gas pipeline.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction on cultural resources in undeveloped areas.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing could occur during construction; loss of 446 operating jobs at OCNGS could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at the site. Some impact on housing could occur during construction.

8.4 Summary of Alternatives Considered

Two alternatives to the existing OCNGS once-through cooling system were considered: (1) a closed-cycle system using linear multicelled hybrid mechanical-draft cooling towers, and (2) modifications to the existing once-through cooling system coupled with restoration of wetlands to offset impingement and entrainment losses at the facility. The closed-cycle cooling system alternative would significantly reduce entrainment and impingement losses from current levels, but could produce some impacts on onsite land use, air quality (salt drift, emissions from fossil-fuel-fired plants needed to offset the energy penalty of the cooling system), visual aesthetics (visible plume under certain atmospheric conditions), and noise that could reach MODERATE levels. Modifications to the existing system coupled with wetland restoration could offset impacts of the once-through cooling system, but restoration activities could produce some adverse impacts on land use, ecological resources (short term), and historical and archaeological resources that could reach MODERATE levels. The magnitude of impacts would depend on the location and size of the area to be restored.

The environmental impacts of the proposed action, renewal of the OCNGS OL, would be SMALL for all impact categories, except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal. Collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal were not assigned a single significance level but were determined by the Commission to be Category 1 issues nonetheless. Alternatives to the proposed action that were evaluated include license renewal with implementation of alternatives to the existing once-through cooling system (discussed in Section 8.1), the no-action alternative (discussed in Section 8.2), new-generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.3.1 through 8.3.3, respectively), purchased electrical power (discussed in Section 8.3.4), alternative technologies (discussed in Section 8.3.5), and a combination of alternatives (discussed in Section 8.3.6).

The no-action alternative would require the replacement of electrical-generating capacity by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) power-generation alternatives other than OCNGS, or (4) some combination of these options. For each of the new-generation alternatives (coal, natural gas, and nuclear), the environmental impacts would be greater than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of OCNGS. The impacts of purchased electrical power (imported power) would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time, and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OCNGS OL.

The NRC staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.5 References

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40 CFR Part 51. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

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9.0 Summary and Conclusions

By letter dated July 22, 2005, AmerGen Energy Company, LLC (AmerGen), submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Oyster Creek Nuclear Generating Station (OCNGS) for an additional 20-year period (AmerGen 2005a). If the OL is renewed, State regulatory agencies and AmerGen will ultimately decide whether the plant will continue to operate based on factors such as the need for power, or other matters within the State's jurisdiction or the purview of the owners. If the OL is not renewed, then the plant must be shut down at or before the expiration of the current OL, which expires on April 9, 2009.

Section 102 of the National Environmental Policy Act (NEPA) directs that an Environmental Impact Statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51). Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Upon acceptance of the AmerGen application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a Notice of Intent to prepare an EIS and conduct scoping (*Federal Register*, Volume 70, page 55635 [70 FR 55635] [NRC 2005]) on September 22, 2005. The NRC staff visited the OCNGS site in October 2005 and held public scoping meetings on November 1, 2005, in Toms River, New Jersey (NRC 2006). The NRC staff reviewed the AmerGen Environmental Report (ER) (AmerGen 2005b) and compared it with the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The NRC staff also considered the public comments received during the scoping process for preparation of this draft Supplemental Environmental Impact Statement (SEIS) for OCNGS. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this draft SEIS.

The NRC staff will hold two public meetings in Toms River, New Jersey, in July 2006, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments on

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

this draft SEIS. When the comment period ends, the NRC staff will consider and address all comments received. Comments will be addressed in Appendix A, Part 2, of the final SEIS.

This draft SEIS includes the NRC staff's preliminary analysis that considers and weighs the environmental effects of the proposed action, including cumulative impacts, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. This draft SEIS also includes the staff's preliminary recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion for the NRC staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed

action and the alternatives, or any aspect of storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[(a)]

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the NRC staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the NRC staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51,

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(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations – generic determination of no significant environmental impact."

Subpart A, Appendix B. The NRC staff also determined that information provided during the public comment period did not identify any new issue that requires site-specific assessment.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This draft SEIS documents the NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OL for OCNGS) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the OCNGS site or at some other unspecified location. In addition, the NRC staff evaluated alternatives to the once-through cooling-water system currently used at OCNGS.

9.1 Environmental Impacts of the Proposed Action – License Renewal

AmerGen and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither AmerGen nor the NRC staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process, AmerGen, nor the NRC staff has identified any new issue applicable to OCNGS that has a significant environmental impact. Therefore, the NRC staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to OCNGS.

AmerGen's license renewal application presents an analysis of the Category 2 issues that are applicable to OCNGS. The NRC staff has reviewed the AmerGen analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Six Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at OCNGS. Four Category 2 issues are not discussed in this draft SEIS because they are specifically related to refurbishment. AmerGen (AmerGen 2005b) has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of OCNGS for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the Final Environmental Statement Related to Operation of OCNGS (AEC 1974).

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in this draft SEIS. Four of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this draft SEIS in relation to operation during the renewal term. For all 11 Category 2 issues and environmental justice, the NRC staff concludes that the potential environmental impacts would be of SMALL significance in the context of the standards set forth in the GEIS. In addition, the NRC staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the NRC staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for OCNGS and the plant improvements already made, the NRC staff concludes that several SAMAs are potentially cost-beneficial. However, none of these SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted. Nevertheless, additional mitigation may be required by the state of New Jersey that would result in further reduction of impacts related to cooling-system operation.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of this analysis, where OCNGS license renewal impacts are deemed to be SMALL, the NRC staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if OCNGS ceases operation at or before the expiration of the current OL would not be smaller than those associated with continued operation of this unit, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of OCNGS during the current license period was made when the plant was built. The resource commitments considered in this draft SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. OCNGS replaces a portion of the fuel assemblies in its unit during every refueling outage, which occurs on a 24-month cycle.

The likely power-generation alternatives if OCNGS ceases operation on or before the expiration of the current OL will require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the OCNGS site was set when the plant was approved and construction began. That balance is now well-established. Renewal of the OL for OCNGS and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OL would lead to shutdown of the plant and would alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the OCNGS site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OL for OCNGS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at OCNGS. Chapters 4 through 7 discuss environmental issues associated with renewal of the OL. Environmental issues associated with alternatives to the once-through cooling system currently in use at OCNGS, the no-action alternative, and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OL), alternatives to the existing once-through cooling system, the no-action alternative (denial of the application), alternatives involving nuclear, coal-, or gas-fired power generation at the OCNGS site and at an unspecified alternate site, and a combination of alternatives are compared in Table 9-1. Closed-cycle cooling systems are assumed for all power-generation alternatives.

Substitution of once-through cooling for the closed-cycle cooling system in the evaluation of the nuclear and gas- and coal-fired generation alternatives would result in somewhat greater environmental impacts in some impact categories.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [see Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

9.3 NRC Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999), (2) the AmerGen ER (AmerGen 2005b), (3) consultation with Federal, State, and local agencies, (4) the NRC staff's own independent review, and (5) the NRC staff's consideration of public comments received, the preliminary recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for OCNGS are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Power Generation Using Closed-Cycle Cooling, Except as Otherwise Specified

Impact Category	License Renewal (Existing Cooling System)	License Renewal (Alternatives to the Existing Cooling System): Closed-Cycle Cooling	License Renewal (Alternatives to the Existing Cooling System): Modified Existing System with Restoration	No-Action Alternative (Denial of Renewal)	Coal-Fired Generation: OCNGS Site	Coal-Fired Generation: Alternate Site	Natural-Gas-Fired Generation: OCNGS Site	Natural-Gas-Fired Generation: Alternate Site	New Nuclear Generation: OCNGS Site	New Nuclear Generation: Alternate Site	Combination of Alternatives: OCNGS Site	Combination of Alternatives: Alternate Site
Land use	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE
Ecology	SMALL	SMALL	SMALL	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE
Water use and quality – surface water	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water use and quality – groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Air quality	SMALL	MODERATE	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Waste	SMALL	SMALL	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human health	SMALL[(a)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL[(a)]	SMALL[(a)]	SMALL	SMALL
Socioeconomics	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL to LARGE	MODERATE	MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Transportation	SMALL	SMALL	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE
Aesthetics	SMALL	SMALL to MODERATE	SMALL	SMALL	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Historic and archaeological resources	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to LARGE	SMALL	SMALL to MODERATE

(a) Except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a significance level was not assigned. See Chapter 6 for details.

9.4 References

10 CFR Part 51. *Code of Federal Regulations,* Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. *Code of Federal Regulations,* Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

AmerGen Energy Company, LLC (AmerGen). 2005a. *License Renewal Application, Oyster Creek Generating Station, Docket No. 50-219, Facility Operating License No. DPR-16*. Forked River, New Jersey. (July 22, 2005).

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